October 3, 1945

NATIONAL PETROLEUM NEWS

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DETROIT

Fists Fly as O.W.I.U. Pickets Indiana Standard Plant

—Chicago Herald-American Photo

Club-armed Oil Workers International Union (C.I.O.) pickets attacked and beat an independent (see lower right of photo) who tried to cross the picket lines at the Indiana Standard Refinery at Whiting, Ind., before the pickets were suddenly withdrawn early Sunday morning. A soldier (extreme left, center) stands by calmly, watching the melee. Other bystanders reacted differently, some apparently attempting either to interfere or take part in the skirmishes.

NPN, with news bureaus in Washington, Cleveland, Chicago, New York, Tulsa, Los Angeles and San Francisco and with special correspondents at a dozen other points, presents the most complete account of the oil strike available in any publication.

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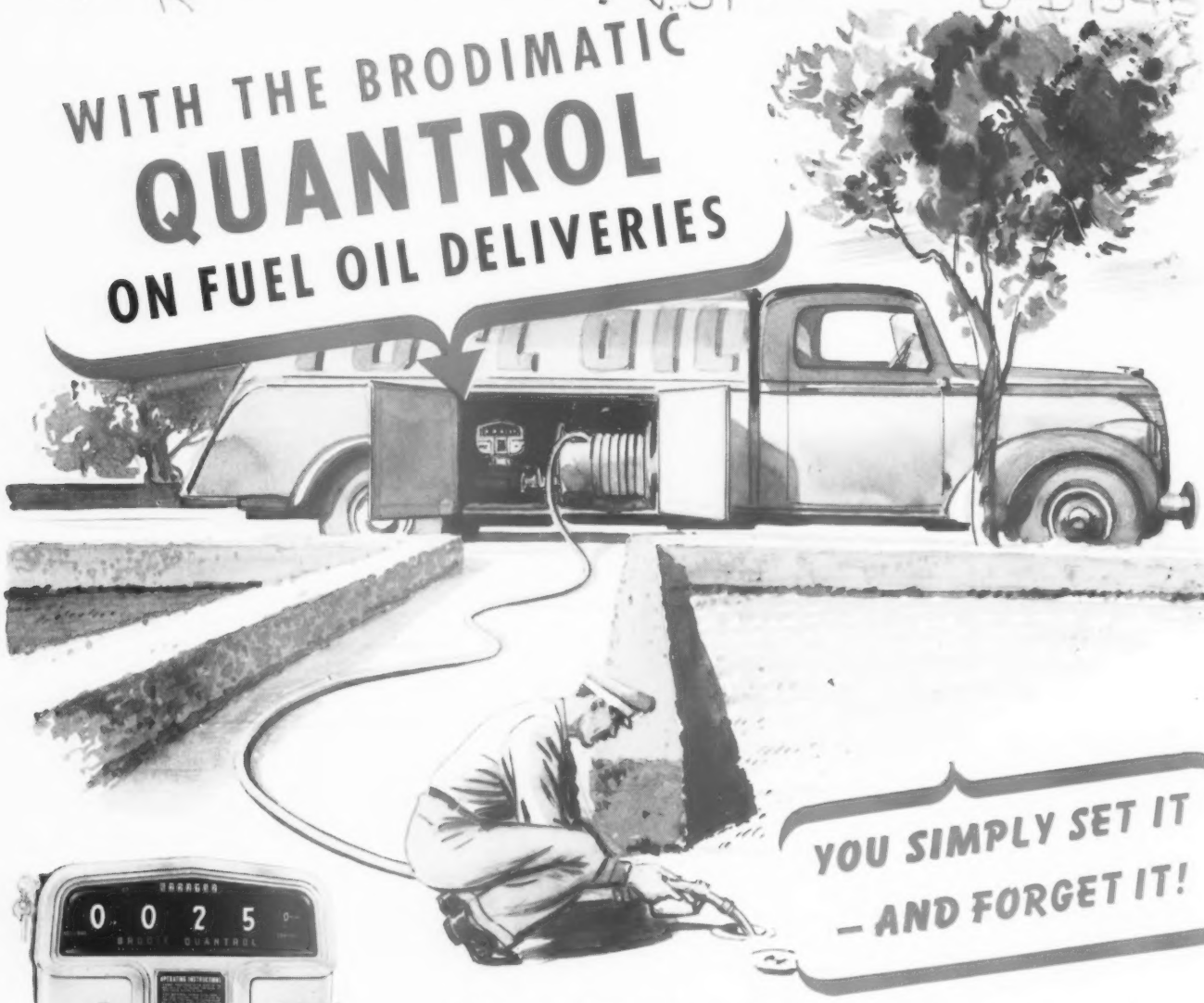

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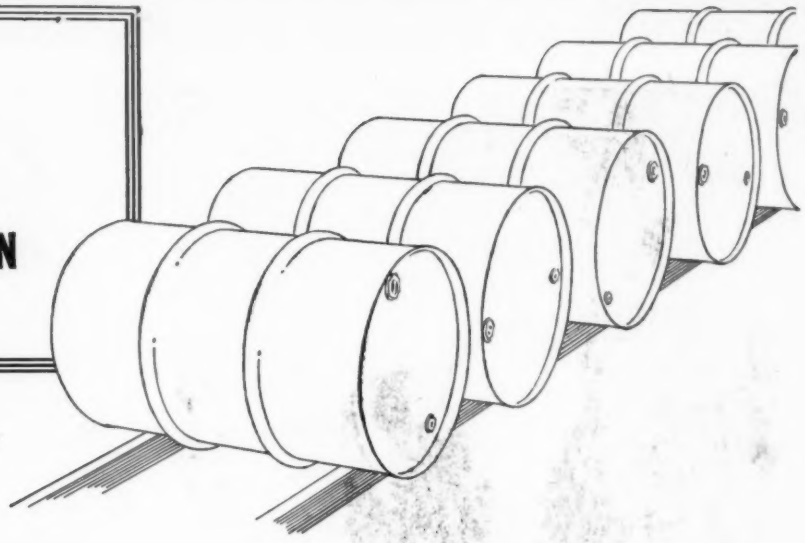

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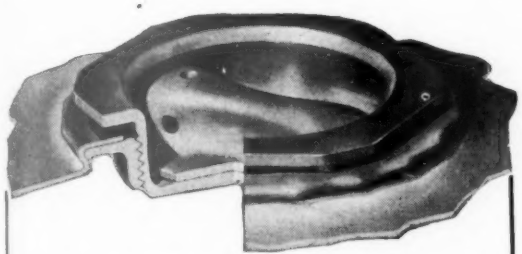

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Score First for Women in Jersey Standard Officer Class

Miss Muriel E. Reynolds, left . . . Mrs. Margery M. Porter

NEW YORK — The largest oil company in the United States last week announced the appointment of the first women it has ever named as corporate officers.

The two new executives are Miss Muriel E. Reynolds of Westfield, N. J., and Mrs. Margery M. Porter of New York City, and both have been appointed assistant secretaries of Standard Oil Co. (N. J.). Both started with the company as stenographers and served in various departments before they were selected as assistants to A. C. Minton, secretary of the parent company of the Jersey group.

Importance In Industry

"The appointment of Miss Reynolds and Mrs. Porter is another indication of the growing importance of women in industry," Eugene Holman, Jersey Standard president, said. "As assistant secretaries they will share the responsibilities in the corporate administration of our company."

Neither of the new assistant secretaries cares to trade on her looks or personality, but both can definitely be described as "attractive." Both, in addition, have had many years experience at Jersey Standard.

Miss Reynolds has been with the company for 19 years, after her first employment as a part-time file clerk. She worked her way through Wheaton College in Massachusetts as a bank clerk during summers. For about a year she taught school in Massachusetts and New Jersey and then she joined Jersey Standard.

Employed In Publishing

Before Mrs. Porter joined the company in 1930, she was employed as a typist-clerk in a publishing house, and later as secretary and office manager in the Thomas Mott Osborne prison reform organization.

Mrs. Porter and Miss Reynolds, as assistant secretaries, will share the responsibilities of the secretary's office in recording company minutes, maintaining stockholder relations and recording corporate changes within the company.

Mrs. Porter was married in February, 1943, to a mechanical engineer (who is not in the oil business), and who has been recently discharged as a lieutenant commander, U. S. N. R. Her hobbies are mountain climbing, skiing, and other winter sports.

Miss Reynolds is a member of the Women's University Club.

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BULLETIN

TEXACO DOWN IN TULSA

TULSA—The Texas Co's. 22,000 b/d refinery was strikebound Tuesday. Strike vote was taken over a week ago, but were not to be counted pending outcome of Chicago conference.

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NATIONAL PETROLEUM NEWS
NPN
NEWSMAGAZINE FOR OIL MANAGEMENT MEN

Negotiations Stalemated As Schwellenbach's Deadline Brings No News At NPN Presstime

NPN News Bureau

WASHINGTON — Management and labor conferees were debating the question of accepting proposal of Labor Secretary Schwellenbach for immediate arbitration of the nation-spanning oil strikes as NPN went to press. (Text of Schwellenbach proposal on p. 42).

Entire leadership of Oil Workers International Union was on scene, as it had been throughout fruitless efforts at conciliation.

But industry representatives kept wires humming between Washington and company home offices as they weighed these implications of Schwellenbach plan:

1. That it would force management to deal on industry-wide basis.

2. That, while it recognizes original demand for 30% pay increase as arbitration starting point for union, it sets 15% as starting point for management, regardless of fact some companies have offered no increase and Sinclair has withdrawn offer of 13% boost.

3. That it would eliminate all questions except that of wages from arbitration.

4. That it would force management to deal on group basis, whereas companies throughout have spoken only individually in view of complexity of local contractual problems and fear of another "Madison case."

Secretary Schwellenbach's move at midnight Oct. 1 to exert new influence upon conferees evoked from Daniel T. Pierce, assistant to president, Sinclair Oil Corp., the observation:

"We are opposed to compulsory arbitration, but we will have to accept it (the proposal) for reasons stated by Secretary Schwellenbach."

The Labor Department chief had declared strikes were putting "in jeopardy the very life blood of American economy," that reconversion and employment would be impossible for lack of gasoline and oil.

During the labor-industry oil strike conference here, industry has placed heavy emphasis upon the irresponsibility of the present union leadership, which industry asserts has wilfully and deliberately broken "no strike" clauses in current labor contracts, has not complied with WLB requirements for 30 day strike notices and other contractual agreements for arbitrating disputes.

Mr. Schwellenbach has stressed the getting of service men back home promptly as a paramount issue in settling the oil strike. Top industry representatives, in reply recognize that obligation, but pointed out that it was even more important to obtain responsible labor leadership now, which will live up to its contracts and obey the law, so that when the service men do return they will have jobs to come back to.

(*Day by day account of meeting on p. 4*)

Union "Courtesy" Gives Fire Department Gasoline

—*Acme Photo*

The "rationing" of gasoline in the Detroit area by the Oil Workers Union (C.I.O.) became the target of Labor Secretary Schwellenbach when he told the union to discontinue its practice. Mr. Schwellenbach's statement followed reports of incidents similar to the one pictured here when Capt. Henry P. Gelinski (right) of the Hamtramck fire department arranged for an emergency supply of gasoline from truck driver Ed Borse. Regular deliveries of gasoline were halted by a strike of drivers, members of Local 389, Oil Workers Union (C.I.O.) in Detroit Sept. 22. Hamtramck is a Detroit suburb

Union Oil Co. Strikebound As Labor Dept. Deadline Neared

NPN News Bureau

LOS ANGELES — Union Oil Co. of California's refineries at Wilmington and Oleum, Calif., closed on Tuesday, as strike negotiations were a few hours from the Labor Secretary's "deadline". (*Earlier story on spread of strikes on p. 6*)

The combined capacity of the two plants is 154,000 b/d. The company has about 2300 employes, but latest figures indicated 1100 as being out. The company was voluntarily shutting down the Maltha refinery at Bakersfield (8500 b/d) involving about 30 people belonging to an independent union.

Reese H. Taylor, Union Oil president, gave NPN the following statement at noon Tuesday, Oct. 2:

"Today Union Oil Co.'s Los Angeles and Oleum refineries were struck by the Oil Workers International Union—C.I.O.—This strike is an illegal one, being in violation not only of the no-strike clause in the existing contract between Union Oil Co. and the Oil Workers International Union but of the requirements of the Federal War Labor Disputes Act, as well.

It will be necessary shortly to close down operations of other departments because of inability to handle the crude oil, or supply the products.

Ban On New Stations, Bulk Plants Off Oct. 15

NPN News Bureau

WASHINGTON — Marketers will be free on Oct. 15 to put into execution long-deferred plans for new retail and wholesale outlets.

Effective that date, PAW announced last week, is the revocation of the last of its materials controls, PAO 12, restricting use of materials or equipment for construction of service stations and bulk plants.

The order, in effect in different forms since 1943, prohibited use of materials and equipment for service stations costing more than $10,000 and bulk plants costing in excess of $40,000.

The way for its removal was opened Sept. 18 when lifting of remaining provisions of WPB's General Construction Order, L-41, was announced by OWMR Director John W. Snyder, effective Oct. 15.

Day-by-Day Summary of Oil Strike Conciliation Meetings

Following is a summary, prepared by NPN staff members, of the oil strike conciliation meetings in Chicago and Washington. The summary carries through the Monday night session:

* * *

TUESDAY, Sept. 25 — Oil company representatives at opening sessions were Daniel T. Pierce, assistant to the president of Sinclair Refining Co. and James Tanham, vice president of the Texas Co. Seven observers from oil companies were:

F. O. Prior, Stanolind Pipeline Co.; W. N. Zabriskie, Socony-Vacuum Oil Co.; James W. Reese and Larry Smith, Pure Oil Co.; H. W. Camp and Charles M. Reed, Cities Service Oil Co.; R. S. Steward, Standard Oil Co. of Ohio; F. E. Rehm, Shell Oil Co.; and S. W. Candee, Tidewater Associated Oil Co. Other observers who took part later were:

Wendell Thayer, Union Oil Co. (Cal.); Clark S. Teitsworth, Howard C. McCarthy and Richard Lowe, Socony-Vacuum Oil Co.; R. E. Smith, Pan-American Petroleum Co.; M. F. McCue, Tidewater Associated Oil Co.; N. K. Norton, Texas Co. attorney; and S. Hinman, Sinclair attorney.

Six of the nine companies fired the first gun, bluntly charging the union with breaking existing contracts and expressing lack of faith in any new ones that might be drawn.

Second salvo came from Sinclair's Daniel T. Pierce who quoted a union local leader at the company's East Chicago refinery as saying it was the purpose of the union "to break the Sinclair Co." Mr. Pierce's determined response was:

"We don't propose to be broken."

He quoted union demands for 52 hours pay for 40 hours work, said it probably would eventually be 36 hours. He pointed to the union's desire for a nationwide closed shop and work shift differentials on a 40-hour basis, and probably later on a 36-hour basis.

He claimed pay increases would amount to 38.1 cents per hour on a 40-hour basis and 56.4 cents on a 36-hour basis.

Judge William L. Knaus, chairman, suggested that companies and the union compromise between 15 and 30 per cent. Representatives of the Texas Co. and Sinclair Oil Corp. said they could not go above 15 per cent, a stand observers believed their companies would take.

* * *

WEDNESDAY, Sept. 26—O. W. I. U. officials started the day with confusing announcement which led many to believe a nation-wide strike had been called involving a claimed 250,000 C. I. O. workers in producing, transportation and refining.

O. A. Knight, union president, later said all that was intended, really, was to "alert" the union's membership by authorizing a strike, "If one becomes necessary."

Trouble was caused by telegrams Knight sent to seven O. W. I. U. district headquarters.

For, after reading Knight's statement to the press, O.W.I.U. Pressman Harvey O'Connor added:

"This means a nation-wide strike of 250,000 O.W.I.U. members in producing, transporting and refining." Ten minutes later Knight had to make his rueful explanation that a difference lay between "authorizing" and "calling" the strike.

Countering a statement by Mr. Knight, in which he charged that only 6.5 per cent of each oil dollar went to labor, Mr. Pierce asserted that this was entirely erroneous as the figure should be from 17 to 18 per cent for direct labor expenditure by the oil industry, and that over all the industry it was 75 to 80 per cent, including labor expense in fabricating materials, such as boilers manufactured by other industries than oil.

Industry and union officials then held separate conferences with Labor Department Conciliators.

* * *

THURSDAY, Sept. 27—The Chicago part of the oil strike conciliation meeting

O.W.I.U.-C.I.O. Officials On Hand For Opening Of Chicago Strike Meeting

Officials of Oil Workers International Union-C. I. O. were on hand for the opening of the strike meeting in Chicago Sept. 25. Shown in the picture (in the section of seats nearest the camera) are:
Seated in front of guard rail—Harvey O'Connor, Director of Public Relations, O. W. I. U.; first row back of guard rail (left to right) O. A. Knight, O. W. I. U. president; B. J. Schafer, Chicago, international representative; E. C. Conarty, international secretary; Thomas M. McCormick, rank and file member; A. R. Kinstley, Vice President; William Trombley, international representative; Hugh Campbell, international representative; second row—E. Carl Mattern, Vice President; William Urban, Executive Council member; B. J. Rickey, representative; L. L. Crane, Executive Council member; E. S. Krusee, member; J. T. Tidwell, Executive Council member; R. L. Clark, Executive Council member; third row—James J. Covey, member; D. R. Steward, Executive Council member; Ivan B. Haven, member (head of Detroit local); G. W. Gaston, member; W. W. Allen, representative; back row—Forest Tillman, member; J. A. Lee, Executive Council member; William Hanscom, Executive Council member; an Army Captain, not a member of O. W. I. U.; and John Cardwell, member

ended as a result of a telephone conversation between Labor Secretary Schwellenbach the previous evening with Judge Knaus, chairman.

Washington was determined as site for the continuation of the negotiations, Edgar L. Warren, chief of the United States Conciliation Service announcing the same representatives would participate.

Knight voiced this sentiment for the union:

"The international union regrets that the entire matter failed of settlement. However, the international union will be present at the conference in Washington."

Conciliator Warren said the strike was tying up reconversion and was the most critical labor situation in the country.

Management representatives agreed to attend the Washington meetings, and made these points, in opposing union's demands:

1. The National War Labor Board some time ago designated the bargaining units for the industry on a local basis and built a fence around them, which as things stand now prohibit the industry from making a nation-wide contract even should it desire to do so.

2. O.W.I.U. represents only a small minority in the oil industry.

3. In considering dealing with O.W.-I.U. on an individual company-wide basis, the problems involve what to do with the A. F. of L. locals and independent unions as all big companies have some of them in their setups.

4. The majority of oil company employes do not belong to any union.

5. If the oil industry did undertake to bargain on an industrywide basis with the O.W.I.U.-CIO, there still would be many local problems that could not be met and the industry would be compelled to go back to local bargaining.

6. The oil companies have for years been trying to develop good industry relations in each plant as a matter of both union and public policy to avoid the impression of monopoly or centralized control at the home office. Now, if compelled to bargain nationally, the authority given local managers and refinery superintendents to bargain locally would have to be taken from them.

7. Fundamentally, national bargaining, like centralized governmental control in Washington, is not democratic in the eyes of the oil industry. Many local unions would accept the 15 per cent pay increase offered, industry men declare, if international headquarters would let them.

Knight claims local bargaining broke down and gave that as his reason for desiring national conference with U. S. conciliaton, but that statement is not borne out by facts offered by the oil industry.

For instance, head of the O.W.I.U. local at The Texas Co. refinery at Lockport, Ill., where about 1000 men are employed, was in the refinery superintendent's office working out a local agreement with the management when pickets showed up outside in front of the plant, Texas Co. officials declare.

The local O.W.I.U. chief excused himself while he went out to get rid of the pickets, but in a moment returned to say that he never saw the pickets before and that they had come from Hammond, Ind. Negotiations on a local basis were broken off, because the local chief said he and his men could not pass the picket line. Other similar instances have been reported at plants other than those of Texaco. In the Calumet area of metropolitan Chicago, pickets are on all plants, including those of Standard of Indiana where local bargaining has been in progress.

Finally, the industry turned to U. S. Department of Labor statistics indicating a 28 per cent increase in the cost of living, contrasting it with a 5 and 6 per cent increase in service station prices, with the price of crude at prewar levels.

* * *

FRIDAY, Sept. 28—Traveling from Chicago to Washington.

* * *

SATURDAY, Sept. 29—The meetings began with each side presenting a 15-minute summation of its position, after which the conferees were told by Secretary of Labor Schwellenbach that this was "the most important meeting in the world today" and that they "owed it to democracy" to settle their differences.

Mr. Schwellenbach pointed out he wasn't concerned whether the dispute was settled on an industry-wide basis or not, so long as it was settled, and explained the meeting was called because there wasn't time for Labor Department conciliators to go one by one to the various companies and set up the process of collective bargaining.

After the morning session adjourned, the union talked with The Texas Co., which "stood firm" on its 15% offer, while the O.W.I.U. said it would settle on the same basis that it came to an agreement with the Wilshire Oil Co., Los Angeles—35 cents an hour or $50 a month.

This meant a reduction in some cases, since the average refinery wage is $1.27, and a 30% increase would amount to 38.1 cents an hour. However, the settlement with Wilshire—on a 60-day basis, subject to change as a result of the Washington meeting—amounted to exactly 30%.

Union President O. A. Knight charged the industry united unilaterally against the union to force reductions in wages and provoked "spontaneous opposition," despite the fact that O.W.I.U. had gone out of its way during the war period to avoid difficulties such as those now arising.

At the end of the afternoon session, the union talked with Sinclair, Socony-Vacuum and Pan-American, with no results. A rumor (unfounded) that President Truman might call the conferees to the White House for a "verbal spanking," created a mild stir.

An evening session was called, but adjourned quickly to allow Judge Knous and panel members to confer with Mr. Schwellenbach. At 2 a. m. Sunday morning, the Labor Secretary wired George H. Hoffman of O.W.I.U. Local 210 at Hammond, Ind., asking the union to withdraw its members from participation in the picket line at the Whiting refinery of Standard Oil (Indiana). Mr. Schwellenbach told Mr. Hoffman the Washington conference to adjust the oil dispute was being made "difficult" by the picket line.

Judge Knous sized up the Saturday sessions this way. . .

"It was like watching a poker game from the sidelines, without knowing what the players had in their hands."

* * *

SUNDAY, Sept. 30—Recriminations marked the opening of Sunday's session. Daniel T. Pierce, assistant to the presi-

Justice Knous Confers With Conciliation Officials

Justice William L. Knous (center), who presided at the Chicago conference of Oil Workers International Union-C.I.O. officials and oil industry representatives, studies reports of the strike situation just prior to the opening of mediations. With him are Commissioners August J. Hummert (left), St. Louis, and James O. Hubbard (right), of U. S. Conciliation Service

dent of Sinclair, reported his company's refinery at Wellsville, N. Y. had been shut down by a union-ordered strike while the conference was in session Saturday. It was the first in the East to be affected.

Mr. Pierce said Sinclair had planned to give workers a 13% increase before the strike was called, but was withdrawing its previous proposals in view of the "open, flagrant and continued breach by the union of its agreements and the evident purpose to bring about famine and privations to meet its demands."

Mr. Schwellenbach, however, received word from Mr. Hoffman that O. W. I. U. was withdrawing its pickets at the Whiting refinery, and a telegram from A. W. Peake, president of Standard Oil (Indiana), thanking the secretary and reporting that operations soon again would be normal.

No progress was made in conference sessions, and Mr. Knight charged that "at no time in the meetings here or in Chicago have the companies bargained with us. Management simply repeated its ultimatum of 15%."

The union chief said the companies ignored the fact that almost a third of the O.W.I.U. demand, or more than 10 cents, would cost management nothing, since it represented money saved through elimination of overtime pay when they return to the 40-hour week.

Management representatives were quick to point out, however, that with reduction of the work week, more help would have to be hired.

Mr. Schwellenbach sent a telegram to August Scholle, Michigan CIO director, saying the program of the Detroit O.W.I.U local in rationing gasoline "is resulting in confusion and resentment that soon will endanger the health and safety of the people of Detroit" and asking the local to "recognize its responsibility so to conduct itself as not to endanger the public welfare." He said any rationing of gasoline in the Detroit area should be done by "proper authorities."

A meeting of the panel and union conferees occupied most of the afternoon session, during which some of the industry representatives held individual conferences with Mr. Schwellenbach. There was no night session.

* * *

MONDAY, Oct. 1—Discussions between the panel and union representatives occupied most of the day. Mr. Schwellenbach conferred with his conciliators on suggestions that strikers go back to their jobs, companies accept all strikers willing to go back, arbitration be undertaken where contracts called for it, and negotiations be started in other instances.

Secretary Schwellenbach submitted his four-point program for ending the strike.

Strikes Spread During Conciliation Meetings; Small CIO Minority Blockaded Indiana Standard

NPN News Bureau

CLEVELAND—Last week as strike negotiations were being held in Chicago and Washington, the union's "roll of honor" of struck plants mounted. In the oil companies' corner over the week-end seconds viewed with satisfaction the withdrawal of pickets at Indiana Standard's Whiting plant in response to pleas from Gov. R. F. Gates of Indiana and Labor Secretary Schwellenbach for conciliation.

In the other corner, however, the union expressed pleasure when officials of Wilshire Oil Co. in Los Angeles agreed temporarily to meet the demands of Oil Workers International Union (C.I.O.) for 52 hours pay for 40 hours of work.

At Standard's **Whiting** plant the refinery was operating "nearly normal" on Sunday and was not handicapped by the cooling off of minor plant units. A company spokesman said that the company at no time recognized that a strike existed, but declared the C. I. O. pickets "established illegal road blocks" to keep out workers.

The following day (Monday) 175 employes of Keystone Oil Refining Co. and Aurora Gasoline Co. at **Detroit**, were back at work on a temporary basis providing for a 17.5c per hour increase, approximately 15 per cent over the average rates in effect on a contract dated June 20, 1945.

This agreement provides for this scale for the period of Oct. 1, to Nov. 1, 1945. It provides that in the event no settlement had been made on the industry-wide dispute by Nov. 1, the interim wage increase would be raised to 35c per hour for a period of 60 days from Nov. 1. These interim raises will be adjusted up or down to comply with the prevailing rate of increase in the industry in the Great Lakes area on Nov. 1, or as soon thereafter as settlement is reached on the present dispute.

800 Idle At Ashland

But to offset this, announcement came that 800 men were idle at Ashland Oil and Refining Co's. two plants at **Ashland, Ky.** This shutdown followed picketing by a half doen men said to be from Pure Oil Co's Cabin Creek, W. Va., struck plant. At NPN press time, these pickets had grown tired, and tied their picketing banners on a telephone pole. The workers considered this as good as pickets and stayed out of the plants.

Following is a summary of the activities of the unions since NPN's report of Monday, Sept. 24, when 28,810 men at plants with daily capacity of 1,107,900 bbl. were reported. (*See NPN Sept. 26, p. 5*).

As Oil Workers' Union and company conferees met in Chicago to try and unsnarl work stoppages, the Sinclair refinery at **Corpus Christi, Tex.**, was 75 per cent closed on Sept. 25 in preparation for a strike for the following day.

In **West Virginia**, 145 workers, with no arguments, were idle at Elk Refining Co's plant in what was termed a "sympathy strike," following "persuasion" from men said to be from the struck refinery of Pure Oil Co. at Cabin Creek. These workers were given an increase on Aug. 1.

In **Cleveland**, unions were picketing each other. Mounted police broke up clashes between A. F. of L. building tradesmen entering the Standard Oil struck plant through an aisle of mounted police, with police zone cars standing by.

Equipment Field Hit

In Texas, the first report was made of the strike spreading to the equipment field, with the announcement that the U. S. Steel Co. barrel plant at **Beaumont**, with 250 workers, was closed.

On Sept. 27, Crown Central Refining Co. in Texas began closing down, and pickets were around plants of five major companies, Shell, Gulf, Sinclair, Cities Service and Pure. Union estimated 350 of Houston's 350 service stations would be closed by week-end. Charlette refinery at **Chalmette, La.**, joined the procession when workers walked out. This was in the face of the company agreeing to do whatever the Chicago meeting decided upon, a company spokesman said. It was reported that the refinery was not being picketed. R. W. Lawrence, representing O.W.I.U., announced that strike vote would be held among **East Texas** oil workers on Saturday, Sept. 30, affecting 17 companies.

The last major refinery in the **Port Arthur** area, Atlantic Refining Co., was being picketed following orderly closedown. Atlantic employs 400. The strike had been authorized the week before.

On Saturday, Sept. 30, O.W.I.U. pickets temporarily closed Standard Oil Co. of Indiana refinery at **Whiting**, though CIO union has very small membership in the plant. Late that night pickets were suddenly withdrawn.

National Guard Alerted

Mayor James T. McNamara of Whiting and Sheriff Fred Stults of Lake County, Ind., asked Gov. Gates to intercede, after three men were injured in quarrels which arose among workers and strikers during the day's picketing. Four companies of the Indiana National Guard had been alerted, and they stood by in armories prepared to march if called to maintain order in the Calumet refinery area.

United States Conciliation Service representatives also were credited by both the Standard Oil management and the union officers with doing much to bringing about the union's agreement to call off the strike. William J. Murray, the federal conciliator on duty when the strike was called, worked all day and

late Saturday night conferring with both sides.

Standard Oil's Whiting plant was the last refinery open in the Chicago area when the O.W.I.U. threw its picket lines across the entrances. More than 2,000 pickets formed shoulder-to-shoulder lines on 129th St. choking off the output of the plant, which has a capacity of 2,500,000 gals. of gasoline a day—half the total produced in the Calumet and Chicago area.

Eight other Calumet district refineries have been closed by the strike of 6,000 workers, in which the Standard Oil plant had been involved only indirectly. Standard employes have their own union, which has a contract. A company spokesman estimated that only 600 of the plant's 5,100 employes are members of the C.I.O. Oil Workers International. Harvey O'Connor, public relations director for the O.W.I.U. said the pickets were placed around the Standard plant because the 600 O.W.I.U. members there had voted to strike.

The officials at Wilshire Oil Co. in **Los Angeles** agreed temporarily to meet the demand of the Oil Workers International Union for 52 hours pay for 40 hours work.

Strike Called Off

The union had scheduled a walkout from the company's Norwalk refinery at 10 A. M. Saturday. The strike was called off when Wilshire signed the temporary agreement. The refinery, which employs 580, is a closed shop for O. W. I. U.

The 52-40 pay scale will apply, company and union officials said, until national officials of union and major oil companies reach agreement concerning union's similar demand on the majors. If there is an agreement at Washington and it is different from the union-Wilshire scale, the scale set at Washington will apply to Wilshire employes and adjustments will be made for what already has been paid.

Ralph F. Force, general counsel for Wilshire, said Wilshire's pay rates are at least equal to those of rest of the industry. He emphasized that agreement reached here is for only 60 days.

Union had announced that it was demanding Wilshire give 52 hours pay for 36 hour week, but conferees said the union did not in the conference demand less than a 40-hour week.

The conference was held in the Wilshire office with the union represented by J. Elro Brown, national representative; Jack Sayre, secretary, and Dan Scott and Frank Sweeney representing Local 128. General Counsel Force, Assistant Secretary W. D. Smith and Personnel Manager J. S. Wilmarth represented the company.

State officials of the union at its Long Beach headquarters said that state-wide walkout of 12,000 C.I.O. men from major oil refineries where they are in control will depend on the negotiations and mediation efforts being conducted in Washington under federal government direction.

The union claims majority control in every major oil refinery in California except that of the Standard Oil Co. of California in Richmond.

Refuse to Handle Shipments

At Terminal Island shipping center for some of the major oil companies, the union has had its members refuse to handle Texas Co. shipments intended for Texas areas where the union is on strike. They served notice also on Shell Oil Co. that they would not allow it to ship products from its Watson refinery to Midwest struck areas.

The union announced that it had directed Shell not to lay off its women workers on that basis when, the union men said, Shell proposed to lay off 35 women. The union said the company could lay off workers only on a seniority basis and cannot segregate women for discharge because they are women. Union spokesmen said the employer expected to be able to get more work out of men.

The Wilshire agreement calls for 35c hour increase which is 30 per cent or 52 hours pay for 40 hours.

Pipeline and production workers in **Creek County, Okla.**, were in process of shutting down, or planning to shut down, according to J. W. Davis, spokesman for local 330 of O.W.I.U. at Kiefer, Okla.

First refinery strike in the East came when approximately 500 employes of the Sinclair plant in **Wellsville, N. Y.**, walked out. Employes were represented by Oil Workers International Union (CIO). The refinery has a normal production of 9000 b/d.

Employes of Sinclair Refining Co.'s refinery and pipeline went out on strike in **Kansas City, Kans.**, while Phillips Petroleum Co. refinery was scheduled to strike, according to W. W. Watson, president of the local OWIU. The strikes involve approximately 1,000 Sinclair and 900 Phillips employes. Reason given for strike was "in line with international policy" to get 52 hours pay for 40 hours work.

The last major refinery in the **Beaumont-Port Arthur** area closed, with the complete shutdown of Atlantic Refining Co., employing around 400 men. Sinclair's refinery at Corpus Christi, employing 325 men was closed.

Pipeline Begins Closing

At Houston the strike enveloped the Crown Central Petroleum Corp., and at the end of the week the long pipeline of Sinclair Pipeline Co. began closing, affecting some 500 men along the network from Corpus Christi to Houston and from East Texas to Houston, and another network from Fort Worth north through Oklahoma. Each network has a capacity of 77,000 b/d. It is estimated that 26,000 men are idle in Texas as the result of the strikes.

In Houston, nearly 450 service stations were faced with the prospect of being out of gasoline. Pickets continued to parade before the bulk plants of Gulf, Pure, Shell, Sinclair, Cities Service and Crown Central.

There are 94 refineries operating in the state. So far only 11 have been closed, and storage of both crude and gasoline are at a high point in the state.

Oil workers in the big **East Texas** field were balloting on calling a general strike, which R. W. Lawrence, international O. W. I. U. representative, told NPN would tie up the entire field and every company operating there. He said Local 207 in the East Texas field represents some 2,000 oil field workers, ranging from rough necks to pipeline operators.

In **West Texas**, the C.I.O. union has called a general policy committee meeting of all locals in the Permian Basin Oct. 3 when a strike in West Texas will be voted on. L. B. Cooper, secretary of Local 413 at Odessa, said his union controls 75% of all pipe line, refinery and oil field workers in the Basin and a strike would be able to close all operations. He estimated membership in the Permian Basin area at 4,000 to 5,000 men.

In Beaumont William S. Povall, another international representative of

(Continued on Page 42)

Strikes At A Glance

CLEVELAND—Following is a summary of strikes since last reported in NPN as of Sept. 24. (See NPN Sept. 26, p. 5).

	Date Closed	Number Employes	Capacity in Bbls. Daily
Elk Refining Co., Falling Rock, W. Va.	9/25	175	3,500
U. S. Steel Bbl. Co., Beaumont, Tex.	...	250	.....
Gulf Refining Corp., (loading rack) Cleves, Ohio	...	13	(*)
Crown Central Petroleum Co., Houston	9/27	...	20,000
Atlantic Refining Co., Port Arthur, Tex.	9/28	400	23,000
Sinclair Refining Co., Wellsville, N. Y.	9/29	500	11,000
Sinclair Refining Co., Kansas City, Kans.	9/29	1,000	12,000
Ashland Refining Co., Ashland, Ky.	9/29	800	32,500
Gulf Oil Tanker, Houston, Tex.	10/1	(†)	.....
Sinclair Refining Co., Sand Ridge, Okla.	10/1	260	5,200
Phillips Petroleum Co., Okmulgee, Okla.	10/1	275	7,000
Socony-Vacuum Oil Co., Augusta, Kans.	10/1	450	23,000
The Texas Co., Galena Park Tex	10/2	140	27,500
Sinclair Refining Co. Marcus Hook, Pa.	10/2	944	65,000
Union Oil Co. Los Angeles, Cal.	10/2	2300	154,000
Total for Week		7507	383,700
Previous Total		28,810	1,107,900
Grand Total		36,317	1,491,600

*Tied up truck loading from refinery.
†CIO Maritime workers refused to cross picket line.

Employes affected include only refinery workers as listed in latest *Platt's Oil Price Handbook* and *Refinery Directory*. The list does not include bulk plant and other employes affected.

Editor's Page

Has Truman Delegated His Reconversion Policy To an 'Arbitrator' and Strikers' Clubs?

DESPITE the great pressure the Truman administration has been putting on the oil industry these last few days and despite the scolding given the oil company men at Chicago by the administration's chief "conciliator", the oil companies are still steadfast in their refusal to take the responsibility for inaugurating the greatest single wage increase in all history, a wage increase that almost every one except the union leaders admit quite probably would invite the inflation that all fear.

This continued oil industry refusal finally forced the Truman administration late this Monday night to step a little bit out in the open in its efforts to get full "take home" pay when industry has returned to the 40 hour week.

The language of Labor Secretary Schwellenbach, in announcing his "settlement" plan for refinery strikes, would quite clearly seem to be an order to the "arbitrator" who will take over the negotiations, to bring in a finding well above the 15% that the oil companies, and even many other businesses, have offered or indicated they might be willing to pay on a new 40 hour basis. Nothing is said in Schwellenbach's announcement as to what, if anything, OPA is expected to do, or may be ordered to do, to make any wage increase above 15% possible, or to protect those businesses that might be thrown seriously into losses by even a 15% increase. But then business, especially the smaller ones, are not organized for powerful political attack on the New Deal and all office holders as are the labor unions.

Shows Pro-Union Bias at Washington

The bias in favor of the labor unions that exists today at Washington is further shown by the criticism by Schwellenbach of the negotiations to-date between oil companies and the unions. Schwellenbach bluntly says: "There has been no collective bargaining. What has happened has been collective refusal to bargain. The union has stuck to its 30% demand. The companies have refused to go above 15%. The conciliation panel has worked patiently in an effort to bring about collective bargaining."

What is "collective bargaining?"

To Schwellenbach it would seem to be a giving in by one or both parties to negotiations regardless of the merits of the other party's claims. Somebody must always win something. According to the long and dismal record the winner must be the unions or they won't accept the results of "collective bargaining". In fact the "winnings" must be quite substantial or the unions will walk out on the findings even to changing their minds, on second thought, and breaking duly signed contracts.

The way the Truman administration is maneuvering to try and get around direct responsibility for a tremendous raise in wages, that will undoubtedly set the wage pace for the entire country, shows that it may have some conception of what will be the result of "collective bargaining" always resulting in some one winning, especially the unions. If Schwellenbach sticks to his idea of "collective bargaining" then the thing which all business and all fair minded citizens fear is most certainly going to come to pass and that is continual "demands" by unions for ever increasing wages with "collective bargaining" winning or the Schwellenbach "arbitrator always allowing something over what has been paid, or is offered, and what the unions demand.

The Rebuke to Davis Is Discounted

Schwellenbach's actions in this oil wage controversy only seem to discount Truman's recent supposed rebuke to the garrulous Davis of the old War Labor Board, after Davis assured a group of labor editors that wages should go up 50%.

The union bias in high places at Washington is also strongly indicated by the absolute silence on the illegal acts of the refinery strikers, the blocking of lawful entry to the refineries, the physical assaults and other acts of mob violence, the arrogant breaking of contracts in which the strikers had agreed not to stop work, and the drawing of "picket lines" across refinery gates where the employes are peacefully at work, by visitors from "struck" plants in other cities. The most ridiculous illustration of phoney picket lines is that where six men allegedly from the Pure's "struck" plant at Cabin Creek, W. Va., drove to the refinery of the Ashland Oil & Refining Co., at Ashland, Ky. and "established" a "picket line" which the Ashland employes, bound by a contract not to quit work, "recognized" even after the six strikers from Pure had gotten tired standing around and gone off to more pleasant spots leaving only their "picket" signs as evidence of the "picket line."

While the chief "conciliator" did tell the CIO Oil Workers Union president to call off the big picket line around the Standard of Indiana's refinery at Whiting, Ind., there is more than a suspicion that what finally dispersed that picket line of some 2,000 was the fact that the governor of Indiana had assembled troops from his national guard in a nearby armory and had given notice that he intended to use them. That the union's president, if he ever ordered the rioting pickets to disperse, may have had little effect on them, is suggested by the fact that some 10 hours elapsed from the time he left the meeting room to give the order in response to the repeated requests of the chief "conciliator" until the mob started home.

Photographs Tell Story of 'Peaceful' Picketing

The criminal illegality of that picket line about the Whiting plant, the cowardly character of its leaders and of the pickets who participated in it is clearly shown by the photographs printed on the cover and elsewhere in this issue. Imagine the "bravery" of these pickets in adorning themselves with large identifying bands and arming themselves with clubs in order

READERS' comments and opinions will be much appreciated by Warren C. Platt, NPN's Editor and Publisher, Penton Building, Cleveland 13, Ohio.

to carry on "peaceful" picketing? Imagine further their "bravery" in a half dozen of them attacking a single individual, in mauling another as he lay helpless on the street, in a dozen or more attacking an automobile load?

And there has not come a single peep out of Truman, Schwellenbach or any other official at Washington or out of the big army of union leaders, by way of criticism or apology to victims and public for these absolutely illegal brutalities. Nor has there come from the unions any offer to compensate these victims, nor to console their families for the brutal attacks.

These are not the first criminal attacks in strikes nor is this the first time that government officials, especially at Washington, and union leaders have refrained from criticism. One may quite properly observe from this record, that the officials at Washington and elsewhere, by their silence are actually conniving with the criminal members of the mob and are equally guilty both of criminal violence and arrant cowardice, for their silence is that bought, or bullied, by the expected votes of the unions and, according to many past illustrations, even bribed by the hard money contributed by these union leaders from union treasuries to the campaign funds of Washington officialdom.

One may say why get disturbed at the mob violence in this refinery strike? It is not the first time violence has been imposed by unioneers on citizens innocent of any illegal conduct, in order to force them to do the union's bidding.

But as Labor Secretary Schwellenbach said at Washington Monday night, "This is no ordinary strike." While he goes on to tell about some of the hardships on the American public this refinery strike may bring, one wonders if Schwellenbach really appreciates how far this strike is from being an "ordinary" one.

One wonders if he realizes that this is the most ruthless and vicious strike perhaps ever made because it is against the whole American people. It is aimed to make the American people accept what a large number of citizens believe is an inflationary wage increase, a wage increase determined only by the union leaders or suffer all the hardships of going back to the horse and buggy days without any horses or buggies.

And this battle of mob violence and threat against the very lives of the American people is being waged, not against a low wage, not against unfair or hazardous working conditions, but to save the soft "velvet" that a previous administration had ordered paid the unions in return for their support for his re-election to high political office.

This strike, which Schwellenbach says is "no ordinary one," is perhaps the most important strike in the history of the country because it in all probability will largely determine the country's nationwide wage policy, one on which our return to peacetime operations will be based, one on which our chances to avoid any great unemployment rests.

There are basic fundamental conditions to be studied in regard to any new wage policy, conditions that call for the best minds of the country. Yet Truman and Schwellenbach would leave the determination of such great questions to a single "arbitrator" and in addition put him under instructions to make the increase, willy-nilly, at least between "15 and 30%." While the union leaders would leave the determination of the economic future of American citizens to the strong right arms of their thugs that wield clubs on the heads of innocent American citizens.

If Truman and Schwellenbach ever expect to have any semblance of labor peace and any degree of prosperity and a free American people, they will have to protect the fundamental rights of American citizens even to calling out the American Army. Permitting the labor leaders (?) continually to trade the administration up and up and ever up, at the expense of the pocketbooks and the rights of the American people certainly is not going to preserve this as a nation of free peoples.

Nazi Technology, Raw Materials Still High—Something Else Beat Germans, Oil Co. Head Says

NPN News Bureau

CLEVELAND—Whatever stopped the Germans and ended the war in Europe, it was not a shortage of technology nor raw materials, J. Howard Marshall, president of Ashland Oil & Refining Co., Ashland, Ky., told the luncheon meeting of Cleveland Petroleum Club Oct. 1, after three months in Europe, where he was general counsel of the U. S. Delegation of the Allied Commission on Reparations.

Referring to the advanced chemical manufacturing technology the Germans used to obtain synthetic and substitute petroleum products, Mr. Marshall said they were making lubricating oils from ethylene and edible fats and oils from a brown coal about the equivalent of lignite in this country.

He said he had seen a synthetic oil plant in Germany which covered 15 square miles and dwarfed anything in this country as far as he knew. Part of the plant looked like tangled spaghetti, he said, showing the effectiveness of pinpoint bombing, but he thought part of it could be put back in shape to run in about six months.

While total production of manufactured goods rose continuously until January, 1945, he felt disruption of transportation, the shortage of oil after loss of the Rumanian fields and damage by bombing to German oil plants, were the factors that stopped that nation.

Mr. Marshall described the ration system in Russia briefly. Each person has a ration card good for minimum amounts of various commodities at fixed low prices. However, those who have the money can buy more at general stores.

Frederick H. Searle Dies

Special to NPN

COLUMBUS, Ohio — Frederick H. Searle, manager for Monarch Petroleum Products for the past 10 years, died on Sept. 8 at Mount Carmel Hospital here. Prior to that Mr. Searle lived for 30 years in Toledo, where he was part owner of the Mona Motor Oil Co. Mr. Searle's father in 1889 founded the Searle, Sons & Co. grease manufacturing plant at Rockford, Ill. Surviving are his widow and two sons, Capt. Frederick H. Searle and Lieut. William Searle, both of the U. S. Army.

Paper Work Beat Germans? Brother, How About WPA?

A thoughtful German told J. Howard Marshall, during his recent tour of Europe: "The reason we lost the war was too much paper work."

Said the Ashland, Ky., Oil and Refining Co. president to the Cleveland Petroleum Club in his recent speech:

"I told him it couldn't have been that. How about our WPA?"

That reminded Mr. Marshall of a remark WPA Director Davies made about a collision of General Petroleum Corp. and Standard of California tankers off the Pacific coast:

"Can't those guys cut out competitive methods even in wartime?"

An added fillip to the Marshall address was his memory of seeing a bomb-blasted Shell Oil Station on a Berlin street, in company with Maj. E. R. Partin of Texas, former oil man. Said the major, longingly:

"As an independent, that's what I always hankered to do to one of the big companies."

Michigan Oil Marketers Hit Refinery Strike, Rationing by Union

Special to NPN

TRAVERSE CITY, Mich.—The Michigan Petroleum Assn., in convention here on Sept. 27, vigorously condemned the CIO-OWIU refinery strike in one resolution and criticized rationing by the union in another. The strike affected 623 jobber members serving 10,921 retail outlets in Michigan. The resolutions follow:

"While this association has always recognized the merits of good and substantial labor organizations representing employes it has also maintained that such organizations should bear a definite responsibility in carrying out their programs; we also believe that industry is entitled to a fair return on its investment and risk.

"Incidents during the last week surrounding the oil workers strike wherein a certain group has sought to take under control the entire distribution of products from the petroleum industry have demonstrated that the responsibility of such organizations has become nonexistent; that the actions undertaken have violated democratic principles of America which we have constantly fought to uphold, that the violations have become so pronounced that any continuance jeopardizes our entire principle of government.

"America has been built on a foundation wherein the majority shall rule. The welfare of the nation is at stake in this particular crisis. The health, safety and well-being of all of the people is being placed in jeopardy by a small minority.

"This association through its 623 jobber members serving 10,941 retail service stations in the state of Michigan is committed to a program to acquaint and solicit the support of the public through its million of daily contacts to denounce the continuance by this minority group of the unfair and un-American practices which have penalized the independent distribution channels retarding the reconversion of industry and have been solely responsible for high increase of unemployment. Further we are committed to nationwide program demanding that our federal and state government representatives provide that protection to which we as taxpayers are entitled."

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"Be it resolved by the Michigan Petroleum Assn. in convention assembled that the allocation of gasoline and petroleum products during the present strike should be handled by the state Governor or by a designated official appointed by the Governor of Michigan, that it is un-American to permit the individual or group of individuals responsible for the present strike to likewise be the sole judge of the essentiality of any use of petroleum products and the means of distribution thereof. We urge that this matter be given immediate action."

Whiting, Ind., Pickets Halt Car Going Through Lines

—Chicago Herald-American Photo

Pickets of the Standard Oil of Indiana plant at Whiting, Ind., closed in on an auto and its driver when an attempt was made to go through the picket lines

Seeks Injunction Against 'Gas' Rationing In Toledo

Special to NPN

TOLEDO, Ohio—This city's self-imposed gasoline rationing program ran into a snag this week.

Steven L. Markowski, Toledo attorney, early this week filed a taxpayer's petition in Lucas County Common Pleas Court in which he asked for temporary injunction to halt the rationing program. He was denied the temporary injunction Tuesday by Judge John McCabe.

As the rationing program found its way into court, the Lucas County Gasoline Distributors Assn. announced it would try to obtain gasoline from outside sources. Association officials said they would seek permission of the C.I.O. to do this and, if refused, would demand that the union close trackside stations which have been doing a land office business.

Mr. Markowski's petition for an injunction names 37 city, union and oil company officials and city employes as defendants. He charges in his petition that the rationing program is contrary to the city's charter, the Ohio Constitution and the Constitution of the United States, and is a misapplication of public funds.

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DETROIT—Rationing of gasoline to "essential" users continued unchanged after the Oil Workers International Union failed in its proposal to Mayor James J. Jeffries that the City of Detroit take over the rationing setup. The mayor, according to the Detroit Free Press, told Gus Scholle, Michigan state C.I.O. director, who made the proposal, that the city was not "in the rationing business."

Texas Will Protect Those Who Want To Work, Governor Says

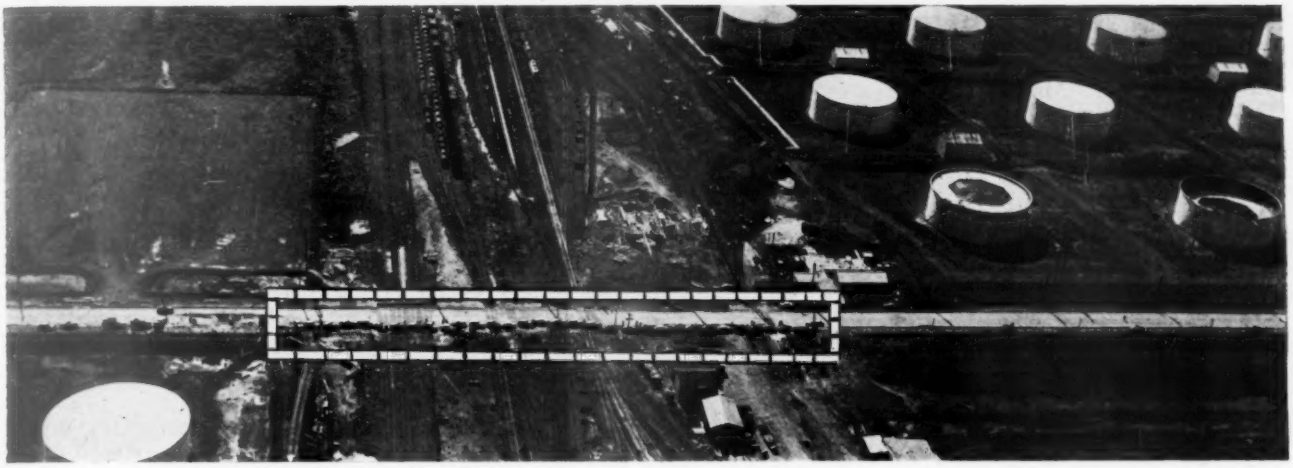
AUSTIN, Tex.—Gov. Coke Stevenson last week warned that the state of Texas will give protection to any person who wants to work in any struck industry. He issued his statement just prior to the announcement that a strike called for last Thursday at midnight against the East Texas Salt Water Disposal Co. in East Texas had been averted as the company and union compromised on a wage agreement.

The governor said that his stand applies also to other plants.

"We can't make anyone work in this state," he stated, "but if workers are found to operate the Salt Water Disposal or other plants in this state, we shall certainly do our best to give them protection."

Gov. Stevenson pointed out that this meant state police would give protection to returning workers in case local officers were unable to do so, and if the job proved too much for state police, the Texas State Guard would be mobilized to protect the workers.

Strikers Use Auto Blockade of Standard of Indiana Whiting Refinery As Violence Breaks Out



Chicago Herald-American photo

An aerial view of the strike-bound Standard Oil Refinery at Whiting, Ind., shows a line of cars (boxed) parked by strikers to cut off railway cars and workers trying to enter. The automobile blockade supplemented masses of pickets. Meanwhile Indiana State Militia troops massed in Gary, South Bend, Whiting and Wabash, Ind., on the alert for possible duty in strike-bound areas. Early Sunday morning however, pickets at the strike-bound refinery were suddenly withdrawn

Chicago Herald-American photo

Violence flared in Whiting, Ind., as members of rival unions, armed with clubs, clashed when independents attempted to crash a C.I.O. barricade at the Standard Oil Company refinery. One man (center of photo) is shown on the ground, surrounded by club-armed participants

Washington—By Raymond E. Bjorkback, Substituting for Herbert A. Yocom

Schwellenbach Knows Government Was Not Prepared to Meet Strike Issue

WASHINGTON—Crystal ball department, medical section:

Even with his recent presidential grants of the Government's major labor agencies and powers, Lewis B. Schwellenbach will find that the biggest headaches to assail him as the country's new Secretary of Labor will be industrial relations.

Mr. Bjorkback

And the brand of aspirin he'll need isn't yet available in the legislative drugstore.

However, it is a pretty good guess that he will seek the remedy diligently. "Judge" Schwellenbach, fresh from the Federal bench in Washington, state, was among the first to admit when he took over at Labor that the government was not prepared to cope with the unrest that sprang up almost before you could say "Reconversion."

He had asked President Truman for considerably more authority than he was given when trouble arose in the automotive industry, only to be quickly overshadowed by the refinery strikes.

At this writing, he has had considerable opportunity to discover that in acquiring the functions, powers and appropriations of the War Labor Board, War Manpower Commission and United States Employment Service, he gained more functions and appropriations than real powers to deal with a very tough proposition.

Nevertheless, he has demonstrated he isn't one to let the bureaucratic grass grow under his feet. He hardly had finished announcing his plan to strengthen his department's Conciliation Service when he appointed a new chief for it, Edgar L. Warren. And that gentleman has been working at his new job with a diligence and energy suggesting his boss's. The men who have been taking part in the oil strike conciliation meeting will testify to that.

But, of the three agencies Mr. Schwellenbach has newly acquired, only moribund WLB is at all useful to him in labor disputes. And he has expressed the hope that the labor-management conference scheduled for Oct. 29 will be fruitful of something to replace the board, because it only makes it possible for him to enter important cases—"go in and find out what the situation is."

Until something new is added, then, he must rely largely on a strengthened Conciliation Service. Understandably, he has been reluctant to resort to the device of Federal seizure of plants, still available.

"That," he observes, "was all right for wartime. But peacetime has come and we've got to get back to peacetime methods."

Meanwhile, he obviously is disposed to improvise. Your Mr. Schwellenbach, headaches or no headaches, isn't one to take just any patent remedy, it seems. While he does anticipate labor difficulties, he has made it plain he does not think additional legislation is needed.

On that point, he can get a rousing argument these days from a lot of individuals he'll be bumping into.

They recommend that the unions be made legally responsible for the contracts their officials sign—just as industry is now and always has been.

They say that's just what the doctor ordered.

Midwest—By Earl Lamm

Resistable Force Meets Immovable Object; Companies Win 1st Strike Round

CHICAGO—The striking thing about the oil strike is that so far a resistable force has met an immovable object. Here are some of the sparks that flew from the emery wheel:

Mr. Lamm

An attacker who does not achieve his objective most certainly fails—the oil companies therefore won the three-day opening bout here. During the meeting, O. A. Knight, president of O.W.I.U., told reporters he had offered to agree with the oil companies that if O.W.I.U. was given the 30 per cent increase it was fighting for, he would insert in the union's contract with the oil companies that O.W.I.U. members would be the only ones to receive the increase since O.W.I.U. was doing all of the battling for it.

And how many new members would that bring O.W.I.U.? A blow like that would most certainly flatten A. F. of L. locals, all independent unions and bring into the O.W.I.U. fold all of the unorganized majority of oil industry employes.

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There are signs that all is not happy within the C.I.O. as you may have noticed. An election meeting of the Chicago Industrial Union Council, core of the C.I.O. locally, a few days ago, broke up in an uproar at 2 a.m. because of a fight between left and right wing groups. The "right wingers" reportedly won at the postponed election Sept. 27, reelecting Albert Towers and Michael Mann as president and secretary.

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President Phelps of O.W.I.U.-C.I.O. Local 210 at Hammond, Ind., which has tied up so many refineries there by striking, was asked at the Morrison Hotel meeting what he thought of the whole situation and replied: "Hell, we may as well find out now on which side of the fence (President) Truman lives!"

Some think the answer is not long off, but we doubt it, since Mr. Truman is an agile tight-rope walker. But with normal curiosity about the outcome, we followed the group—which has become a troupe—to Washington. To prove it's a troupe and not just a group, the first day Justice Knous held forth in Judge Holley's courtroom in the old Postoffice Building in Chicago: after blowing off steam all day, the night session moved to the WLB offices at 332 South Michigan and the next day to the Hollywood Room at the Morrison where the show had a two-day run before it flopped and moved to Washington where it was hoped it would play a one-day stand . . . at last reports it was in its third day.

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Some AFL locals with mechanic memberships and some independent unions as well as some small independent businessmen who were tied up by strikes, attempted to intervene at the first meeting of the conciliation panel and were told to wait.

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At the first meeting, representatives of nine oil companies of 14 on the invited list, appeared. Representatives of four companies said they came as observers, three said they were there but had no authority, leaving only two who came officially prepared to do business if any was to be done. Later, observers for two more companies showed up. It is a well-behaved group of men so far as we can find out, but recognizing the pressure of almost atomic intensity they are under, it is not surprising to hear that back home top officials are nervous for fear their representatives will crack somewhere down the line.

"I feel like a dumb jackass," said one representative, "having to sit silent instead of answering the union's outlandish statements—but if we so much as get up in a joint meeting to answer any union charge and tell them why we cannot go beyond the 15 per cent, we would, in legal effect, be negotiating."

Concerted efforts of newsmen and of several industry representatives to open the meetings to the press failed both at Chicago and in Washington.

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Most major company oil men fear an-

other Madison case and give that as the principal reason for refusing to deal with O.W.I.U.-C.I.O. on an industry-wide basis or take any joint action. One oil man, however, said it was local problems that made it impossible, but it should be remembered that Mr. Ickes sat in with industry during NRA days and still there was a Madison case. It could happen again with Labor Secretary Schwellenbach or his appointees sitting in. Having been knifed once, industry is cautious as proved by Mr. Knight's (O.W.I.U.) frequent statement to the press that industry thus far has even refused to discuss wages in a joint meeting or take any joint action whatever.

* * *

As may be suspected by now, we do not agree with many things Mr. Knight (O.W.I.U.-C.I.O.) says, but thus far the strikes have been without major violence.

* * *

The real down-to-earth reason why oil men appear to be winning the labor-industry strife is that "oil tycoons" are not "tycoons" any more—just ordinary businessmen with a heart, who are willing to meet labor halfway—but they offered the half too quickly.

* * *

Report here in Washington is that neither the long distance phone calls between O. A. Knight and B. J. Schafer, O.W.I.U., Chicago—made at the specific order of Judge Knous—nor the wire sent to Local 210 at Hammond during the wee hours of Saturday morning by Labor Secretary Schwellenbach, had any effect in clearing the pickets at the Standard of Indiana plant at Whiting. It was when the troops approached that the pickets vanished in the night.

John Gibson, special assistant to Schwellenbach (who perhaps will be Under-Secretary of Labor when Congress creates such a position) remained behind on the bench and tried to take charge of the Washington conciliation meeting after Schwellenbach made his brief opening speech and departed. Gibson, a former C.I.O. director in Michigan, began shooting questions at oil's representatives, but when industry inquired who he was and by what authority he was there, he climbed off the bench from his position beside the official conciliators and left. Sunday afternoon, another officious "undersecretary" attempted to repeat the performance and he too was invited to get out.

PIPELINES

NPN Writers at Three Vital Points Discuss the Industry's problems

Atlantic Coast—By Frank P. S. Glassey

Demise of Directive 59 Brings Out Viewpoints Important for Future

NEW YORK—The supply and transportation committee of PAW Dist. 1 held a meeting here last week to consider proposals that it recommend the continuance of Directive 59. No formal action was taken and, as everyone knows, 59 expired gracefully at midnight last Sunday (E.S.T.).

Mr. Glassey

More interesting than the failure to adopt the resolution, however, were the views expressed by some of the industry representatives who attended the closed session. Interesting, particularly, because they reflected three distinct viewpoints which may often find expression in future months.

No one suggested officially that the refinery strike was the spark that touched off the flame of demand by some major companies that the life of Directive 59 be prolonged. Indeed, the chief proponent of the abortive resolution stressed that it was entirely unconcerned with the labor turmoil; that it stemmed from a generally unsatisfactory East Coast supply situation, aggravated by the failure of WSA to reduce tanker rates (as promised) and by the non-arrival of deliveries pledged through the Little Big Inch.

That was one viewpoint. This executive argued that Government should continue the job it started several years ago, at least until supply conditions in this area again become normal.

A second opinion was voiced by another executive who said, in effect:

"The entire suggestion is undesirable and has absolutely no justification. It would amount to industry asking the Government to continue its control of peacetime operations, and would mean that we were actually inviting national socialism into the industry."

The middle view—and the one that prevailed—was this:

"No, we are not inviting socialism—that's an extremist position. Just the same, if we adopted a resolution urging continuance of 59, it would be a definite mistake, since we would be invoking government aid in a strike. We would be seeking to palliate a condition that should be dealt with at the source; that is, at the refineries.

"If the Government must move in, let it do so to adjust the labor situation. Meanwhile there is no use in trying to ease that troubled condition by asking the Government, or one of its agencies, to guarantee us an assured supply when the root of the trouble is untouched."

Those three views appear particularly significant, in anticipating the many problems affecting the industry and labor that will arise in the future. One spokesman wants government intervention, a second scouts any appeal to government on the ground that that would be a turn to the left, and the third says that agencies of government should be invoked only when they can act where a dispute has its origin.

The same arguments will be heard time and again in the next few years, and each is well worth weighing now.

* * *

The S & T Committee meeting, incidentaly, did adopt two resolutions, although it ignored the expiration of Directive 59.

One resolution reminded the Government of failure to reduce tanker rates, as had been tentatively assured. The other, sent to PAW in Washington, said that 2,500,000 barrels of gasoline and 600,000 barrels of heating oil had been promised this area, via the 20-inch line. It deplored the failure to deliver, and said that it might cause some shortage in certain sections.

* * *

Returning veterans are most interested in establishing themselves in service stations, according to the N. Y. State Commerce Dept. A survey last week revealed that the top business goal of the ex-G. I. is the oil industry, and that letters asking about an opportunity in this field top all the rest.

* * *

Some sound advice to service-station operators was handed out by Milton B. Whiting at the recent meeting of the North Carolina Oil Jobbers Assn. Mr. Whiting said:

"I have been in the oil business since 1912, and I have found that the fellow who deals in price cuts is the fellow who can least afford to start it. The big companies require but just a little push to send them over a precipice, and when it hits us it is an avalanche.

"I would suggest that all of us build or repair our present stations. Keep them modern but don't over-build. Super-service stations are all right in big cities but in the average town of 10,000 or less you are only going to draw business from about four blocks, so build a plant to take care of the area from which you will attract. If you have a nice parking lot you can make some money if you are in a busy section. Keep your stations neat, paint them frequently, even if it costs more than it should.

"We need new equipment. There are two things required to retain a customer. One is to see that he has good, well-appearing equipment; the other is good service. See that he gets the products you say you will supply."

Pettengill Says Union Seeks Power Under Guise of Pay Dispute

NPN News Bureau

NEW YORK—Charging that Oil Workers International Union leaders are conducting an industry-wide campaign for concentrated power under the guise of a wage dispute, Samuel B. Pettengill, columnist, author and former congressman, asserts: "Concentrated power will be used to take the whole nation by the throat whenever it is decided to shake more dollars loose."

"That happened twice in time of war in the coal industry and may happen again in that industry," Pettengill says. "Twice John Lewis, with his hand on the lever of industry-wide bargaining, compelled even the government of his country to knuckle to his will.

"Industry-wide bargaining puts the economic jugular vein of 138,000,000 people in the grasp of one man or a small group of men. Anyone who fails to see parallels between the situation developing here and the way a small group of men became masters of Russia a quarter of a century ago is blind to history.

Cites Industry's Record

"For the moment I pass by the question of wages. It may be that the petroleum industry should make some agreement on that score in the light of the advance in the cost of living, although petroleum wages have doubled since 1926, and the prices of its products, due to better methods and machines, has fallen one-third—a record unmatched by our guardian government. When they are forced upward faster than productivity warrants, wage scales, of course, will meet consumer resistance, slow down production and force men into breadlines. But wage scales have never overturned governments. Concentrated power has.

"The petroleum industry is fighting to keep this country free, in insisting upon bargaining at the level of local labor unions, thus permitting industrial flexibility to both management and men in the light of local conditions, and in refusing to bargain with a single union on a nation-wide basis.

"If the C.I.O. can extend its control over the whole petroleum industry, then the pattern is set for its march to power over automobile production, farm machinery, food industries, electricity, housing, transportation and every segment of American life. Then nothing but a nation-wide strike such as England had in 1926, or the use of troops will determine who is master.

"For industry-wide bargaining under existing law is not only concentrated power: it is irresponsible power. It is the power of invisible government, careless of the welfare of millions."

—Berryman, Washington Star

Editors Comment on Oil Strike

HOW TO GET GAS

We gather from a Sun Oil Co. advertisement that Sun is willing if it is guaranteed police protection, to deliver gas to its customers.

There is no reason in the world why Sun should not deliver gas, for Sun employes are not on strike.

Sun employes are not members of the CIO union which is on strike against certain other oil companies.

If Sun drivers are not on strike, why do they not deliver gas?

Why, it is because CIO'ers who are on strike against other companies are picketing Sun properties.

Of course these pickets have no more legal right to picket Sun than they have to picket a plumbing shop in Alaska, but in their arrogance they do it.

What can be done about this almost unbelievable situation?

Just one thing:

If Sun is willing to deliver gas, its men and trucks should be protected by Detroit policemen, or by State Policemen, by Michigan State Troops, by United States Army troops, if necessary.

The issue is a handful of pickets vs. the tens of thousands of Detroit motorists who must have gas for their daily work, for hauling food, for protecting health and for just plain driving if they wish so to drive.

This is a challenge to Detroit, to Michigan, to the Federal Government, and, more important, to the people themselves.

Washington continues its do-nothing policy.

President Truman passes the problem on to the Secretary of Labor, and that gentleman, Mr. Schwellenbach, merely makes another statement saying the strike "must" end by next week, and sends a few more telegrams.

Now it is time for police action!

It is time for the Mayor to assure Sun Oil that policemen are ready to protect its men and employes whenever they are ready to serve the public.—Detroit News

• • •

GUN ON THE TABLE

When representatives of the oil industry and the C.I.O. Oil Workers Union opened the government-sponsored conciliation conference in Chicago in an effort to end the strike of oil refinery workers, Secretary of Labor Lewis B. Schwellenbach sent a telegram to Judge William L. Knous, the conference chairman, stressing the necessity of reaching a peaceful agreement.

"I wish you would explain to the representatives of both industry and labor," Schwellenbach said, "that in your conference they are being given an opportunity for free collective bargaining and that there is great possibility that the confidence of the public in that method may depend upon the success of their efforts."

It now develops that the union did

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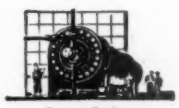

Process Equipment of All Kinds

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not enter the conference in a spirit of conciliation. Moreover, the union has made a mockery of the "free collective bargaining" promised by Schwellenbach. For it began the negotiations with a gun in its pocket. It has now laid this gun on the conference table, announcing in effect that the strike will be settled on its terms, or not at all.

The union weapon is the threat to expand the strike from its seven-state status to a nation-wide refinery shutdown.

O. A. Knight, union president, calmly announced that he had been authorized to call a general strike, if he thought such action advisable. This would affect 250,000 workers, as compared with 35,000 now on strike.

When one party to a dispute enters a negotiation carrying such a weapon, and boldly proclaims his willingness to use it, any semblance of free collective bargaining goes out the window. If the issues are settled at all, they cannot possibly be decided upon their merits, because such a conference must necessarily be dominated by a fear of what would happen if the gun were fired.

Everyone knows that a nation-wide refinery shutdown would cause industrial paralysis. The nation's economy is geared to the gasoline motor and without fuel it would come to a stop, just as surely as Ben. Patton's tanks did before Metz a year ago.

The oil workers' union now brazenly asserts that it is willing to bring this condition about in order to compel the industry to grant a 30 per cent raise or 52 hours pay for 40 hours work. This is the result of the New Deal's coddling of unions and its enactment of one-sided labor laws which have given the unions tremendous power, while exempting them from any responsibilities to the public or to management.—*Cleveland Plain Dealer.*

° ° °

LABOR INVITING REVERSES

Strike statistics are running into big figures. The fact that 350,000 were out on strikes yesterday is bad enough in itself; production is thus directly delayed. But still worse are the indirect but unavoidable troubles to follow — the constant creation of bottlenecks, the increase of unemployment, the deprivation to consumers, bad effects upon every line of industry and traffic. All this tends to upset and confusion.

All this is leading to retribution for organized labor. There is little doubt that the public is storing up resentment and will locate the strike promoters and leaders as oppressors. Reversals are practically certain; the organizations are forfeiting much of the respect and confidence they have long enjoyed; they are too mercenary and demanding.

The news stories show the wide range of disaffection, the spreading idleness, the creeping paralysis. From the automobile center, Detroit, the fever has spread incongruously—to the skyscrapers of New York, refineries all over and the woods of Oregon. Shipbuilders are striking too. Every strike breeds another, and every penalty for a strike gathers compound interest as it goes along.

If there is logic in the combined efforts of the C.I.O. and similar bodies the public cannot discover it. There is a strenuous fight for a 30 per cent increase in wages and for shorter hours; there is persistent demand for $25 a week for 26 weeks for the idle. With that comes the instigation to idleness. On top of all that, the organizations yell for lower prices and reduced taxes.

In the name of common sense, how are all these things going to be done at once? This is a time when all concerned are struggling to get on their feet and get away from the exactions of war time. War was an excuse for a great deal of excess, waste and surrender; we put up with lots of afflictions just because there was a war. Would the C.I.O give us to understand that its choice is limited to war or stagnation or ruin? Under the guise of "the right to work" there is a campaign to prevent anybody from working except under express commission of some "board" of the partisan sort sitting in Washington or New York and Chicago and spreading dictation all around.

The public is facing a very serious condition and will be impelled to action pretty soon. That action is likely to be disagreeable to the labor bosses who are now stalking industry and the public interest and cowing politicians. Pay day always comes.—Tulsa World.

° ° °

THE PEOPLE

CIO union officials graciously permitted the Mayor of the City of Detroit and the Police Commissioner to consult with them concerning what they considered a sufficient supply of gasoline for vital municipal necessities.

These union leaders magnanimously agreed that gasoline might be used by the municipal bus lines, the fire and police departments, the Health Board, the hospitals, airports and United States Government agencies, such as the postal system.

Doctors, nurses, undertakers, clergymen, food agencies and newspapers were also granted special dispensation.

As a patriotic gesture, men and women in the armed services were told they might have some.

All such grants, of course, were declared subject to change in the judgment of the union.

It was to be taken for granted of course, that the CIO candidate for Mayor, Richard Frankensteen, would have what gas he might need for his big limousine. to careen around the city proclaiming the blessing of the New Order.

But you, if you are just an ordinary tax-paying citizen, are in a different classification.

You have no more personal liberty or individual rights than a political slave in a communist factory of Russia.

You will take no rides into the country, go to no football games, nor even go to work unless you are willing to pay a terrific price on the black market for YOUR supply of gasoline. This is dangerous as the goon squads may smash both your car and your head for violating CIO orders.

If this is not dictatorship then Hitler was a democrat.—*Detroit Free Press.*

° ° °

POLICY—OR STRATEGY?

Petroleum industry strikes threaten to deplete the nation's gasoline and oil supply. Secretary Schwellenbach gets management and labor representatives to meet with a conciliation board. He tells them they are being given "an opportunity for free collective bargaining." And he warns them not to fail to agree on something that will mean immediate return to work. Agree on what?

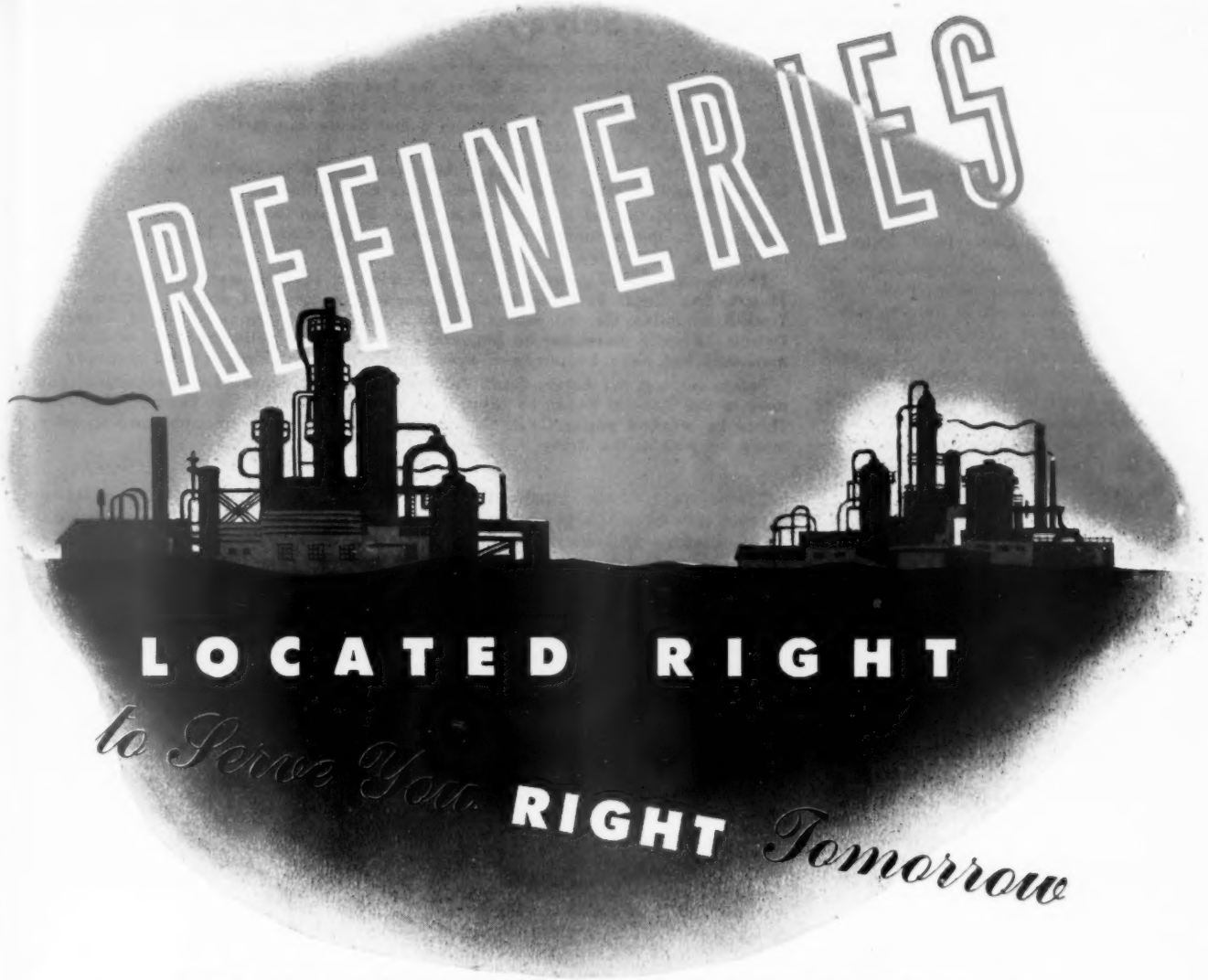
On a wage increase subject to government disapproval if it would cause an inflationary price rise? If so, the bargaining is not free. If the bargaining is to be free the Government must keep hands off the bargain, no matter what it does to prices.

Is the Government prepared to keep hands off if the petroleum workers, having taken up the strike weapon, who refuse to lay it down for less than they demand—a 30 per cent hourly wage increase, meaning 52 hours' pay for 40 hours' work? Does the Administration believe that such an increase could be confined to one industry? Or that, extended to many industries, the effect could be anything less than to blow the lid clear off prices?

We think not. The Administration knows a good deal about the facts of economic life. But it is not saying all it knows. It is not telling workers what is true—that if they get everything they are demanding right now they would cause a price inflation that could defeat all hope of full employment and higher living standards in years to come.

Instead, the Administration is leaving it to industry to resist labor's demands. In our opinion, it is counting on industry to put up enough resistance so that unions will settle temporarily for hourly wage increases of 10, or 12, or 15 per cent, call off strike threats for a while and let reconversion proceed.

That may be smart political strategy. It puts the whole burden of opposing labor on industry. It may enable the Government to approve some fairly moderate wage increases, in the hope that they won't do too much obvious damage to price ceilings, and to say that the Government has permitted free collective bargaining. But, as a policy, it is neither clear nor courageous.—*Cleveland Press*



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Oil Industry Know-How Helped Solve Army's Vapor-Lock Problem

Desert Tank Tests Conducted in Winter of 1942-43 Illustrate Cooperation of Armed Forces, American Petroleum Companies

By Capt. F. S. Peterson

Capt. F. S. Peterson, author of the accompanying article telling the way in which a small, ingenious unit solved the fuel problem for the United States Army tanks which later rambled almost at will over Europe's bomb-blasted terrain, went on active duty in April, 1942 as a first lieutenant in the tank engine section of the Office of the Chief of Ordnance.

Later transferred to the Tank-Automotive Center in Detroit, he was assigned to the vapor lock tests he describes, in the California desert.

Upon completion of this test work Capt. Peterson returned to Detroit and was assigned as the ordnance representative on the Ordnance Department Industry Integration Committee for Engines.

This committee "disintegrated" in the spring of 1944, its work having been completed, and Capt. Peterson was re-assigned to the tank engine section of the Tank-Automotive Center, which by then was called Office Chief of Ordnance, Detroit. Shortly thereafter he became a victim of the polio epidemic of that summer, and has been hospitalized ever since. He is making a good recovery.

Before joining the Army, Capt. Peterson spent six years as a mechanical engineer in the Beacon Research laboratory of The Texas Co., at Beacon, New York. There he worked under C. E. Cummings, who was also his commanding officer while he was in the Army.

A good example of cooperation between the petroleum industry and the Armed Forces is found in the vapor-lock tests conducted at Camp Young, Calif., in the winter of 1942-43. The work was originated and sponsored by the Ordnance Dept. of the Army, while the technical personnel and know-how were supplied by various petroleum companies from their research laboratory staffs.

The tanks used by the Army when we first entered the war had evolved to their current excellence (like Topsy, they "just growed") with changes made here and there by anyone who felt like it. The fuel system comprised a maze of pipes, valves, manifolds, filters, and other gadgets stuck here and there in the overcrowded engine compartments, and the performance of these vehicles in the hot summer months of 1942 left much to be desired.

Vapor-lock, or boiling of the gasoline in the fuel system so that the carburetor receives insufficient liquid fuel to operate the engine, occurred frequently, either while the tank was in operation, causing engine surging and loss of power, stalling or prevented re-starting.

Ready for Summer

The Ordnance department therefore conducted tests in the winter of 1942-43 so vehicles would be ready to operate in the summer of 1943. The program was set up and supervised by Col. Carl E. Cummings, chief of the engine section of the Tank-Automotive center in Detroit formerly of the Texas Co. Research Lab. at Beacon, N. Y.; technical personnel were scheduled by the Cooperative Research Council; laboratory facilities, data analysis and reporting were handled by the Ethyl Corp. laboratory in San Bernardino, Cal. CRC and Ethyl were reimbursed by the Ordnance Dept. for actual test expenses but the time of the technical personnel was donated by their respective companies and crews were changed every month, so no man had to remain away from his company for long. Leadership of the test group also passed from hand to hand, but finally settled on Gilway from the Ethyl laboratory, who performed an excellent job.

The tests were run at the desert training center, Camp Young, about 30 miles east of Inida, where armored divisions trained to fight. It offered a good site to operate tanks under severe loading conditions and high atmospheric temperatures in the winter months. For administrative purposes the test group was placed under the wing of the Desert Warfare board at the camp, but direction came from Detroit.

Fifteen civilian mechanics installed test equipment, made modifications to the fuel systems, and kept the tanks running. Stockton Ordnance Depot, Stockton, Cal. supplied them and 24 enlisted men to drive the tanks and other vehicles furnished from the training personnel at the camp.

The mechanics were under the supervision of Lynn E. Baker, of Sinclair Refining Co., in Chicago, for the entire five months of the program. He did an excellent job under trying conditions.

Lieut. Roy C. Crone from Col. Cummings' staff at T-AC, formerly sales engineer for the Chicago district of The Texas Co., became executive officer in charge of this group.

He was replaced by Lieut. F. S. Peterson, also from Col. Cummings' staff, formerly at the Texaco Research laboratory.

Six tanks of each of the five then current production models were used for test purposes, so that results indicated what might be expected from that class of vehicle, and were not influenced by mechanical irregularities which might be present in one or two vehicles. Test instrumentation consisted of a pressure gauge connected at the carburetor inlet, and numerous thermocouples so that temperatures could be obtained throughout the fuel system while the vehicle was in operation. The pressure gauge, thermocouple selector switch, and potentiometer was mounted in the turret of the tank, so the observer could have a relatively comfortable place from which to make observations.

The test procedure consisted of running the vehicles in convoy on the highway for three hours in the morning at 20 mph. They were allowed to stand in the sun during the noon hour, and then run around a heavy sand course in a canyon for a final heating-up. All this operation was on a fuel which would not cause vapor-lock.

The fuel valves were then switched over to draw test fuel for the hottest fuel tank in the vehicle (which had been determined in a previous temperature survey conducted on the vehicle), and the tanks were operated around the sand course on the test run. Observers recorded temperatures and fuel pressure at short intervals, and watched for vapor-lock as evidenced by uneven engine operation, backfirinng, black exhaust smoke, sudden drop in fuel pressure, or engine stalling while idling. While the engines were idling, fuel samples were siphoned from the tanks into one-quart cans by the water-displacement method for vapor pressure and distillation tests at the laboratory that night. The test runs were repeated.

Were Run Again

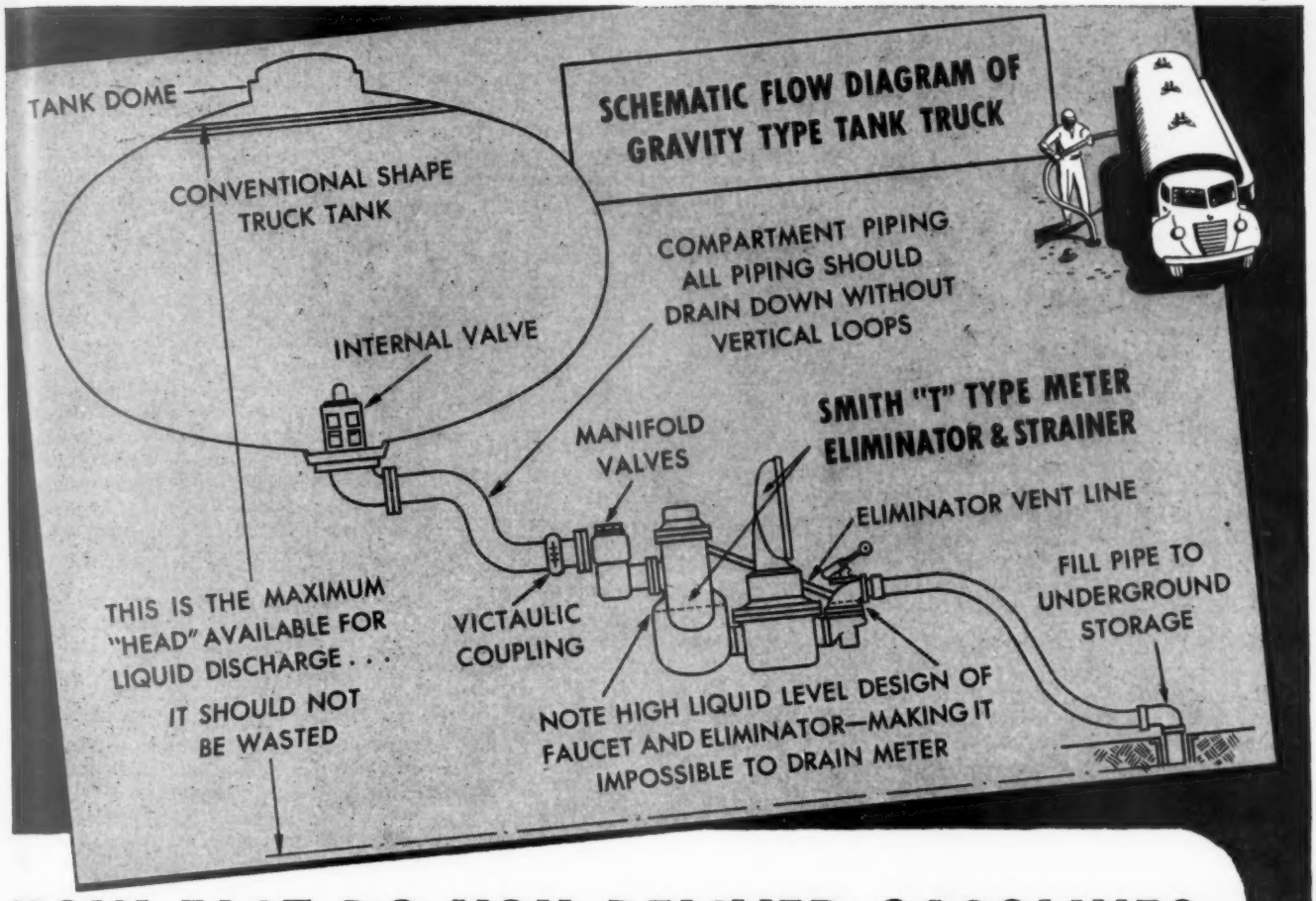
The next day the tanks were run again, using a higher vapor pressure fuel if no vapor-lock had been encountered the day before, or a lower pressure fuel if vapor-lock had been encountered, until the fuel for incipient vapor-lock had been determined for that particular tank model. Six tanks were operated each day, since that was all that could be conveniently handled by the crew available.

After determining the vapor-locking characteristics of the vehicles with the production fuel system in them, these systems were removed and new simplified systems were installed. The tests were then repeated on each group of vehicles. Thirty-two tanks were tested altogether and this included two experimental ones.

The Army wanted to develop a tank that could run on either gasoline or Diesel fuel, so that it might operate on whatever stocks of fuel were at hand or captured from the enemy. With this in mind, vapor-lock tests were conducted on one tank powered by a commercial type two-cycle diesel engine.

It is interesting that the engine operated quite satisfactorily on 80-octane gasoline, which would normally be considered rather poor Diesel fuel, and the tank was run 1500 miles. Vapor-locking was about average, since it locked on a fuel of higher vapor pressure than some of the others but of lower pressure than the best of those tested.

Once the engine had locked, however, it was impossible to restart it without tearing down almost the entire fuel system and clearing it of vapor; it was


SCHEMATIC FLOW DIAGRAM OF GRAVITY TYPE TANK TRUCK
TANK DOME
CONVENTIONAL SHAPE TRUCK TANK
INTERNAL VALVE
COMPARTMENT PIPING ALL PIPING SHOULD DRAIN DOWN WITHOUT VERTICAL LOOPS
MANIFOLD VALVES
SMITH "T" TYPE METER ELIMINATOR & STRAINER
ELIMINATOR VENT LINE
FILL PIPE TO UNDERGROUND STORAGE
THIS IS THE MAXIMUM "HEAD" AVAILABLE FOR LIQUID DISCHARGE . . . IT SHOULD NOT BE WASTED
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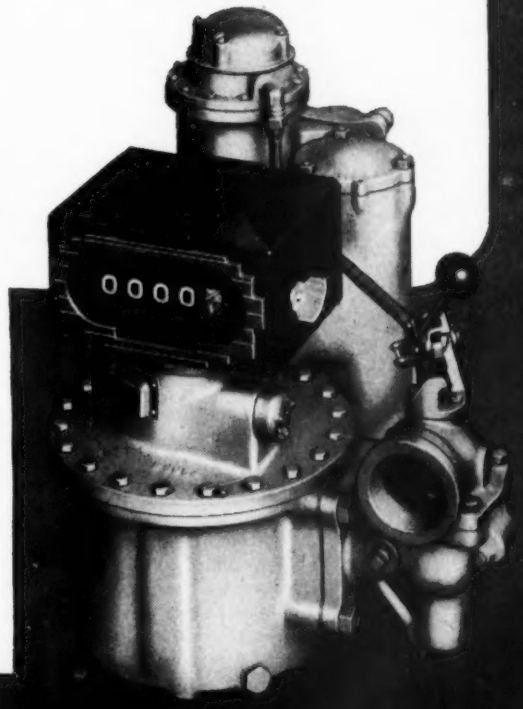

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quite objectionable from that standpoint.

In the middle of the test program, the armored divisions with which we had been working were moved away and the test group was forced to become almost self-sufficient. By hook or crook the "executive officer", now a procurement officer, company commander, paymaster, and several other officers all in one, scrounged up a service fleet that finally numbered 14 vehicles—a wrecker, a tank transporter truck and trailer for recovering unserviceable vehicles from the test course, a Ford sedan, three jeeps, a Dodge command car, two 2½ ton 6x6's for carrying parts, fuel, food, personnel, etc., and four 750-gallon 6x6 tankwagons for holding test fuels.

We inherited from the departing divisions an old air compressor, a steam jenny, a broken down shop building, a row of tents, and another building which was used for a combination office and storeroom. The rest we had to make or procure for ourselves.

Along with the troops went our mess hall, so we made arrangements for our entire group to eat at the camp officers' mess. This was three miles from our bivouac, so at meal time all available vehicles were pressed into service to get to chow and back, and woe betide him who missed the last truck. The divisions left 18 enlisted men to serve as drivers, and these bunked and messed with the Headquarters Company of the camp, also three miles away, further complicating the transportation situation.

Repair Parts Lacking

The repair parts situation became acute also, so the executive officer and the Ford sedan traveled the countryside borrowing items from depots, units encamped here and there, or sometimes procuring them almost out of thin air. Between the daily search for parts, and the nightly trip to deliver gasoline samples to the lab, the "staff car" covered more than 5000 miles per month. Its regular tires proved unequal to this desert service, since many of the Ordnance companies were encamped away from any highway, so jeep tires were substituted and the car went through the sand as though it were built for it. The jeeps and trucks were in constant use around the camp and with the tank convoy.

The special ingredients used for blending test fuels were stored in four tanks in an unused bulk station owned by the Union Oil Co. at Palm Springs, Cal., and loaned for this work. The fuels were loaded into the 750-gallon tankwagons and trucked to the camp, connected to regular service station dispensing pumps mounted on a wooden platform, from which the gasolines were measured into the fuel tanks of the vehicles in the desired quantities to produce the final blend. Natural gasoline in barrels was also dispensed through one of these pumps.

Among the things that made life for the test crews interesting was the occasional sudden disappearance of one of the necessities of life. One Sunday morning we came back from church services and found that in our absence the post signal officer had ripped out the wires leading to our telephone, and except for a doubly-locked door would have taken the instrument too. The previous users of the phone had notified him that they no longer needed it, so he took it out. If we wanted a phone we would have to get approval from the corps area signal officer in Phoenix. Three days went by while we tried to get this approval, but the reply finally was that we didn't need a phone and couldn't have one.

In the meantime our daily calls from Detroit were referred to the Desert Warfar Board, three miles from us. There a courier hopped in a jeep and sped down to us, located the proper party, and drove him back to the Board. By that time the operator had tired of holding the line open and had disconnected the call. Then the call had to be placed in reverse, and by that time the line to Detroit was busy. This went on for three days, until finally the president of the board took hold of things personally. Presto, in half an hour we had a phone, with no approval from anywhere, and it stayed for the duration.

Away Went Plumbing

On another occasion I strolled from the repair shop up past our combination latrine and wash-room to the group of tents. As I passed the shower room I glanced in casually and noted that the oil burner was still functioning and all was well. I might mention here that the hot water supply was furnished by a very nice little unit, a small horizontal boiler heated by a regulation gun type oil burner. We operated it on diesel fuel, and it did much to make life in the desert livable, since a hot shower did wonders after a day of sand and perspiration and grease.

Anyway, 20 minutes later I walked back down to the shop, and there outside the shower room was the oil burner, boiler, and all the piping from the building. The GI's were just climbing into their truck to depart, and if I had been a minute later I would have sworn that the plumbing had removed itself from the building. This magic little job was done by the post engineer and his gang, but turned out not to be his fault.

Someone in authority had told him we were still using a shower room, and to take out all the rest of the buildings but leave ours. However, they gave the wrong number for the building to save, so we would have been left with a shower room that was not equipped with an oil burner. After a half day of chasing around the camp we secured the necessary approval to have the oil burner and pipes reinstalled, but it took the men 25 minutes to put back what they took out in 20.

The tests were finally completed in five months, instead of the two months originally allocated, but the results were entirely satisfactory. The changes, as applied both in production and in kits to tanks already in the field, consisted mainly in reducing the number of valves in the fuel system, relocating the fuel line in a cooler and more direct line from tank to engine, substituting an automotive type diaphragm fuel pump for aviation type gear pumps and bypass valves, and relocating the fuel filter. All tanks operated satisfactorily when revamped in this fashion, and no further reports of widespread trouble from vaporlock have been received.

At the conclusion of the test some of the tanks were returned to depots for re-working and issuance to troops, and the rest, along with the service equipment, were transferred to Camp Seeley, Cal. Here further work was done to round out the program, and all transport vehicles were tested. Test methods and procedures were similar to those used at Camp Young, with necessary modifications because of the different nature of the vehicles.

The results of these tests were of immediate value to the Army in the prosecution of the war, but in addition the information obtained will be used by the manufacturers of post-war vehicles, and the methods and techniques developed will broaden the viewpoints of the men from many companies who took part in the work. The value of the tests is therefore quite far-reaching.

Carter Oil Revealed as Maker Of Secret Weapon for War

TULSA—One of the secret weapons of the war the "VT X Fuse", was made by The Carter Oil Co. here (subsidiary of Standard Oil of New Jersey). The projectile contains a complete radio sending and receiving set arranged in such a way that a radio signal is continuously emitted while the shell is in flight. If a shell passes near a plane, a weak signal is reflected back to the shell and received, causing the shell to explode instantly.

Carter's principal task in connection with the development of the VT fuse has been to provide devices within the projectile which will positively prevent accidental explosion of the shell in the magazine of a ship, in the bore of a gun, or at any time until the shell is on its way and has traveled a considerable distance toward the target, according to the announcement.

CORRECTION

A story on page 51 of the Sept. 26 issue of NPN said that the Army's service station near the village of Sillery in France services 500 trucks in two minutes. This incorrect statement was the result of a typographical error in NPN's office. The station has 73 refueling outlets on the island and usually handles about 50 trucks at a time.

#4 in a series of advertisements discussing postwar refining processes.

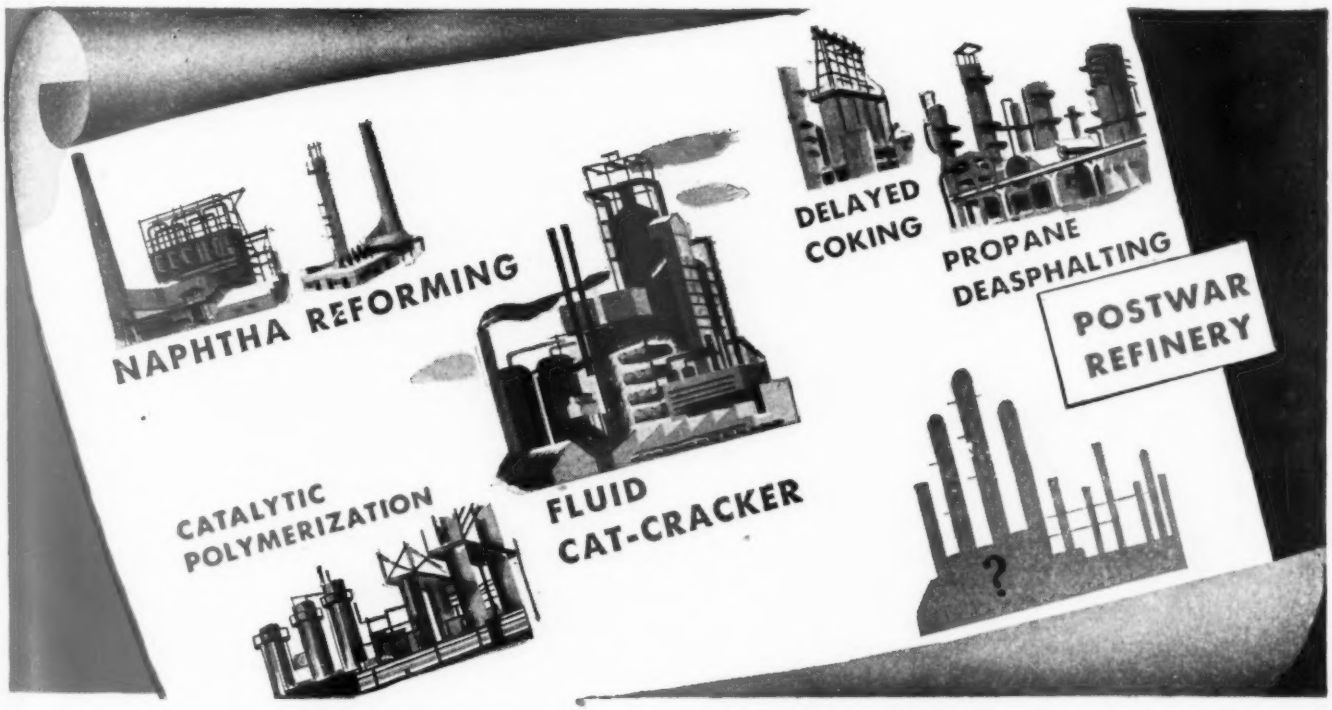
CATALYTIC POLYMERIZATION
for maximum efficiency in utilization of Fluid "Cat-Cracker" Yields

THE ECONOMIC ADVANTAGES inherent in catalytic polymerization of gases to produce a product suitable for stepping up both the yield and quality of motor gasolines is widely recognized. The reason for this is, of course, that gas products from catalytic-cracking are normally highly olefinic.

To begin with, in catalytic polymerization, the resulting polymer is uniformly high grade, motor gasoline. Second, installation costs are low for the catalytic process since it requires temperatures of only 500° F. Third, these low temperatures obviously contribute to overall low operating costs.

Here is a single example of the performance that can be expected of a Kellogg catalytic installation. Polymerization of the gases from a 20,000 barrel *Fluid* "cat-cracker" can produce as much as 1500 barrels per day of high octane gasoline at a direct operating cost of 1.5¢ per gallon *including royalty* . . . resulting in an extremely short payout-time on capital investment.

Of course, figures vary with the individual case. Kellogg will be glad to examine the feasibility of installing new or expanding existing catalytic polymerization facilities.



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Engineers and Economists to the Petroleum Refining Industry

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Welcome Back - - -

And Other News About Oil Soldiers and Sailors

Wearing the proud Legion of Merit for "outstanding and meritorious services" in Italy from Oct. 21, 1943 to May 8, 1945, **Maj. J. D. McCamey** on leave of absence from Carter Oil Co., since November, 1942, has returned after 28 months overseas and becomes assistant to the company's personnel manager.

Major McCamey

In the Army he was petroleum officer at supply depots in the Tunisian campaign and was a member of a joint British and U. S. Ground and Air Force coordinating agency. He served in Italy on the Adriatic Base Depot Group as base petroleum officer.

A native of Sistersville, W. Va., he began work with Carter Oil in the yard gang there April, 1917 and then went to Junction City, Ohio, where he was assistant production foreman when he left for brief army service in World War I. After his return he worked for the company and also was graduated from University of Pittsburgh as a mining engineer. After a South American assignment, he went to Carter Oil's Grisso plant at Seminole, Okla. and was made safety engineer in 1935.

° ° °

Lieut. Col. John F. Troja is back in the United States and is head of the equipment division for the disposal of overseas war surplus, a recent announcement by the Army-Navy liquidation commissioner states. The announcement says that Col. Troja and his staff must answer all questions directly concerned with disposal of surplus equipment, approve disposal for certain categories of property which the field commissioner may not dispose of without reference to the Washington office, and furnish general information and policies to the field commissioners.

Col. Troja, a native of Fort Madison, Iowa, was with the Standard Oil Co. and the Arabian American Oil Co. before entering the Army. He was called to active duty in the Army in 1942, from Saudi Arabia. He served in the Persian Gulf Command until early this year.

° ° °

Maj. James C. Thomas, Portsmouth, O., has announced that he will engage in business with his father, **James D. Thomas**, a Texaco distributor at Portsmouth, upon his release from the service.

Maj. Thomas has been in service in Iceland, England, France and Germany for nearly five years.

Maj. David H. Foster is back from the European war theatre where he served last as Deputy in charge of the Air Corps supply office at Paris. Major Foster was for years with the Mid-Continent Petroleum Corp., Tulsa, Okla.

Oil Man Pressed The Button That Released Atomic Bomb

NPN News Bureau

CLEVELAND — An oil man, Capt. Kermit Beahan, on military leave from Humble Oil Co., pressed the button that released the second atomic bomb on Japan at Nagasaki on Aug. 9.

Capt. Beahan, a bombardier aboard the superfortress, "Great Artiste," loosed the lethal weapon on the enemy that was credited with winning the war, on his 27th birthday.

He enlisted in the air corps while working at the Baytown plant of Humble in 1941. A veteran of thirty missions over Europe and North Africa, Capt. Beahan had been in the Pacific only six weeks before he let go the bomb to end all bombing.

Capt. Beahan's war record is a saga of action plus. On his first mission he was a member of a fortress crew that completely obliterated a fighter airdrome in France. This was quickly followed by bomb planting on Rotterdam, followed by the crew fighting off fifteen German fighter planes in a running 15-minute battle over the English Channel. At least four German planes were shot down. When the plane landed, six men climbed out, carrying one dead and three who had been wounded.

After ten raids over Europe, Capt. Beahan made 20 raids over Rommel's forces in North Africa where he figured in three crash landings, bringing his total to four.

In his first African crash landing, his plane was forced down in enemy territory near the Algerian-Tunisian border. Arabs appeared out of the desert and an Arab in a tiny Austin car sped up and greeted the crew. For four days the Americans lived in a haystack while the natives showered them with food. Later the crew located a truck and made their way back through enemy lines to their own forces.

Capt. Beahan won the Distinguished Flying Cross, the Air Medal with clusters and the Purple Heart. In a special interview for *The Bee*, Humble House magazine, Capt. Beahan praised the production record at the Humble plant, and urged the force to "keep pulling the trigger".

Hero Decorated at Oil Meet

Railroad Commissioner Ernest O. Thompson of Texas pins the Legion of Merit medal on Lieut. Col. Ray Lynch for his service with the 36th Division in Italy and France. Col. Lynch, a former employe of the commission, rose from an enlisted man to G-4 in the 111th Quartermaster Regiment, formerly commanded by Col. Thompson. Col. Lynch received the decoration from his former commanding officer in ceremonies immediately preceding the statewide oil proration hearing in Austin, Sept. 14.

Lt. Col. W. R. Wrigley of the Army Air Forces, POL Section at General Eisenhower's headquarters in Paris, is back and out of the service. Col. Wrigley was in the foreign service of several oil companies for many years both in Europe and in Asia. Not long before his return to this country, he was promoted from a major to a lieutenant colonel.

° ° °

1st Lt. C. L. Bruce Ellsworth, oil operator of San Antonio, Texas, has just returned to the U. S. He joined the Canadian Air Corps at the start of England's entrance into the war, went overseas and was transferred to the Royal Air Force in which he flew for more than a year. When the U. S. came into the war, he transferred again to the U. S. Air Forces. After making his allotted flights he for the past year has been attached to the Air Corps petroleum supply office in Paris.

° ° °

Lt. Col. W. R. Boyd Jr., son of API President Boyd, is just about out of his Army uniform which he has worn for the last four years. His last foreign assignment was in charge of USTAF office at Paris for Air Corps petroleum supplies. At the moment he is awaiting final discharge papers. Col. Boyd has spent his dozen business years in the oil industry in oil marketing. Since his return he has become a marketing coun-

TIME
Plastics for compact cases . . . . Containers for take-out treats
Pails, all styles and sizes . . . . . And cans for luncheon meats
ALL ARE MADE BY CONTINENTAL CAN COMPANY
Lovely ladies use Continental products. So do service station attendants, chemists, soda jerkers, babies, and housewives (to name only a few.)
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Today, of course, our main job is making vital war products. But when the war is won, keep your eye on Continental and on the Continental trade-mark. You'll be seeing the Triple-C more and more in your home and in industry.
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Tune in "REPORT TO THE NATION," every week over CBS coast-to-coast network.

Another in the series of Continental's advertisements appearing in full color in leading national magazines—Time, Newsweek, U. S. News, Business Week, Fortune. Keep your eye on Continental and on Continental's trade-mark, too! The Triple-C stands for *one* company with *one* policy—to give you only the very best in quality and service.

sellor for Petroleum Advisers, Inc., at 70 Pine Street, New York, which is part of the Cities Service Oil Company setup.

° ° °

With his Captain's uniform in mothballs, and a brand new job as Indiana state manager (northern Indiana) **H. V. "Pappy" Smock** is back with The Texas Co.

Capt. Smock

He served 26 months in the AAF, 15 of them in England. He is also a veteran of World War I.

Before entering the service, Mr. Smock held various executive positions in Texaco's sales department. At the time of his promotion he was zone manager for metropolitan Indianapolis. He received his latest promotion when **E. R. Snider** was promoted from state manager to assistant division manager of operations for the Indianapolis division.

° ° °

Maj. Harold M. Davidson left Petroleum Division, OCE, in August, 1944 to return to Standard-Vacuum Oil Co. as refinery engineer. Holding a similar position with Standard-Vacuum before the war, Maj. Davidson operated a petroleum terminal in the Netherlands East Indies for the company until the Japs came in 1942. He joined the army in Australia at that time, remaining until Aug. 1944.

° ° °

Capt. Howard A. MacDonald, an independent driller who operated in South America and in California before the war, left the Petroleum Division, Office of Chief of Engineers of the Army, in August, 1944. When last heard from by his former associates at OCE, he was fishing and enjoying himself generally at Yellowstone National Park. Capt. MacDonald has several producing properties, OCE spokesmen said.

° ° °

Maj. Seldon D. Butcher, geologist and production engineer, hopes to get back to the Rocket Drilling Co. at Wichita, Kan., after several years of pipe laying in Europe.

French Officer, Former Oil Man, Wins American Medal

Special to NPN

CASERTA, Italy — Capt. Alfred Tibor was recently awarded the American Bronze Star Medal for meritorious achievements while a member of Petroleum Section, Allied Force Headquarters, Mediterranean Theater of Operations, U. S. Army.

Capt. Tibor, formerly of Operations Department of the Socony-Vacuum Oil Co., as manager of that company's refinery at Notre Dame de Gravenchon S. Inf., in Normandy province, France, is now serving with Service Des Essence, French Army.

The citation read in part: "Capt. Tibor aided materially in the development and implementation of the petroleum supply plan for the invasion of Southern France. Through his personal knowledge, meticulous review of existing data and continued estimation of the latest intelligence sources, correctly evaluated and guided the initial preparation for petroleum supply into Southern French beaches and ports."

Capt. Tibor also holds the Croix de Guerre with Silver Star. He joined the French Army early in January, 1943, while in Algiers, North Africa. He saw combat at Salerno, then at Naples with the U. S. 82nd Airborne "All American" division, and finally in operations at Southern France.

Corrosion Engineers' Convention Set for May, '46 In Kansas City

Special to NPN

HOUSTON, Tex.—The National Association of Corrosion Engineers will hold its 1946 annual meeting and convention in Kansas City, Mo., May 7, 8 and 9, with headquarters in the President Hotel, Elton Sterrett, N.A.C.E. executive secretary, announces.

Technical sessions are scheduled in the Little Theater Building with space to accommodate the sectional and group meetings. In addition to the technical programs covering the three-day sessions, there will be an exhibition of corrosion-resistant, corrosion-mitigation and various types of protective materials in the main arena of the municipal auditorium.

The program, as outlined, includes papers on corrosion practices as developed in representative industries, such as power plants, municipal and other waterworks, transportation companies, buried communication lines, refineries, chemical manufacturing and processing plants and oil pipelines. Simultaneous sessions are scheduled to permit coverage of the program within the allotted time.

Large Attendance Expected at Indiana 'Victory' Conference

Special to NPN

INDIANAPOLIS, Ind.—Advance registrations indicate a large attendance at the Victory Conference of the Indiana Independent Petroleum Association to be held Oct. 10 and 11 at Hotel Severin.

Warren C. Platt, editor of NATIONAL PETROLEUM NEWS, will be the first speaker. His subject will be "Oil Men on the European Battlefront." The other speaker the first day will be E. J. Gallmeyer, vice president and director of sales, Wayne Pump Co., whose subject will be "The Difference in Salesmanship."

The next day Fred Holt, news editor, Radio Station WIRE, will open the program with a talk on "What of Tomorrow?" J. A. Wooten, cargo traffic manager, American Airlines, New York, will speak on "Air Freight of the Future," and F. Harold Van Orman, Evansville, Ind., will speak on "Postwar Planning for Industrial America."

A closed session of marketers will be held for election of directors the first day of the session.

Name Committees to Arrange For Gas Association Meeting

NPN News Bureau

CHICAGO—Board of Directors of the Independent Natural Gas Assn., meeting in Kansas City, Sept. 17, voted to hold the annual meeting of the association in Dallas on Nov. 26.

Nominating committee was appointed by President Buddrus to fill vacancies on the board and make recommendations for election of officers for the ensuing year. Committee is composed of Burt R. Bay, Joseph Bowes, Wm. H. Wildes, J. H. Dunn, B. A. Hardey and Frank Buttram.

Also appointed was a convention arrangements committee composed of Wm. H. Wildes, C. H. Zachry, John A. Ferguson and Charles L. Orr. To arrange the program for the meeting a committee, including D. A. Hulcy, Clyde H. Alexander, N. R. Royall, Jr., and John A. Ferguson, was appointed.

Postwar Problems on Agenda At Natural Gasoline Fall Session

NPN News Bureau

LOS ANGELES — Postwar problems of refiners, producers and natural gasoline manufacturers will confront the 20th annual Fall meeting of the California Natural Gasoline Assn. at the Biltmore Hotel here Oct. 12.

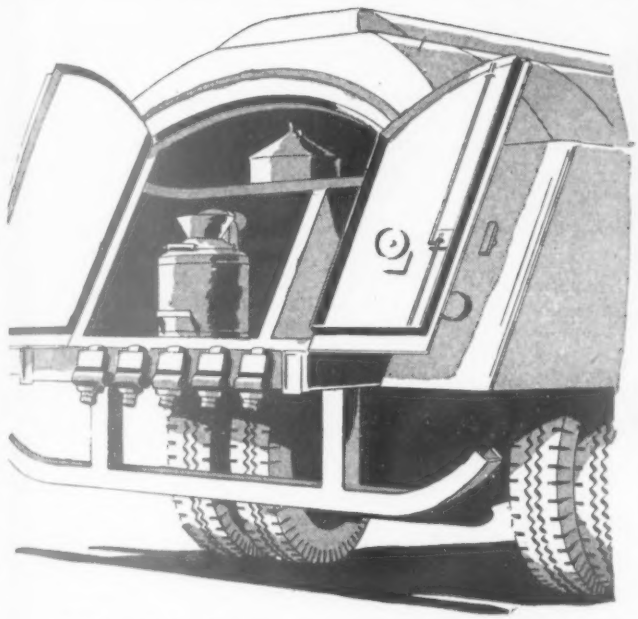
Speakers on all three phases of the petroleum industry have been selected by W. L. Rifenberick, who heads the fall meeting committee. They include: H. A. Gehres, vice president of the Cooper-Bessemer Corp.; E. W. McAllister, chief engineer of Western Gulf Oil Co.; M. M. Perkins, process engineer of M. W. Kellogg Co.; F. D. Parker, consulting engineer; Fred Hartley, Union Oil Co., of California.

Association President Marion L. Arnold says problems to be discussed will include "finding a use for the millions of dollars worth of equipment installed for the production of stocks used in the manufacture of high-octane aviation gasoline and for the light hydrocarbons used to meet the needs of the 100-octane program."

Rain Hampers Oilmen's Golf

Rain hampered the Chicago Oilmen's Fall Golf party at Arlington Heights, Ill., Sept 13, but inside the clubhouse, Phil Crippen, Roy Thompson, Ray Pentz, C. J. Wood and H. J. McDonald of Kansas did some singing, R. P. Baker, Frank Spencer, Henry Plane and G. LePine starred at bridge and golf winners who braved the weather included: Roy Jacobs, Jack O'Connor, J. Plunkett, Bill Snyder, D. R. Forsberg, M. Tiege, S. Hill, J. Gibson, R. Lohse and J. Moll.

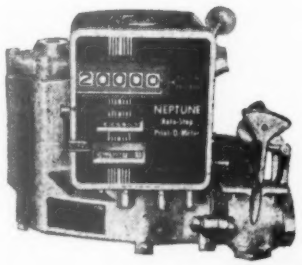
HOW MUCH DO YOU MAKE ON UNCOUNTED BUCKETS?



Without doubt you can come right back and say: "Nothing—I lose." For if you "give away" an extra bucket, through miscounting or spillage, it's your loss—and if lifting and lugging heavy buckets all day makes you too tired to worry about full measure, you lose the confidence of your customers.

Neptune metering enables you to account for every gallon handled; makes possible accurate, fast, easy deliveries. Product losses formerly caused by spillage or overmeasure are eliminated. Moreover, such business-like deliveries earn the full confidence of customers, eliminate disputes.

So it all adds up that Neptune Red Seal Meters, installed right in the line with power take-off, pump and hose, control costs, guard your profits, and gain goodwill for you. With a Print-O-Meter Register on the Neptune Red Seal you can give each customer a printed receipt or invoice covering every delivery—keep copies for permanent bookkeeping records. Don't delay—write for full details today.



The 1¼" RED SEAL Compact Meter

This Red Seal Meter has all the essential equipment for accurate tank truck metering. Strainer, air release valve and back pressure valve are assembled with the meter casing —save valuable payload space and weight. Auto-Stop feature favored. Print-O-Meter Register is also optional.

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A642

Research Gets Big Cut In Standard (Cal.) $20,000,000 Program

Special to NPN

SAN FRANCISCO—The use that oil companies make of their earnings, the subject of a recent statement by the Oil Workers International Union (C.I.O) as a reason why companies should increase pay 30%, is answered in part by an announcement by H. D. Collier, president of Standard of California, of plans for a construction program totaling more than $20,000,000.

The largest part of these expenditures, Mr. Collier said, will be at the Richmond and El Segundo (Calif) refineries, where approximately $15,000,000 will be expended. Included in this amount is nearly $2,000,000 for expansion of the Richmond laboratories and plants of California Research Corp., Standard subsidiary.

Additional Outlays Planned

Indicating the additional large outlays Standard has in mind, Mr. Collier said:

"We anticipate spending many more millions for normal replacements, repairs and betterments during the next few years."

The announced program, suspended by the war, will include additions and improvements to refinery, storage, distributing, producing and office facilities of Standard and its domestic subsidiaries.

In addition, the company is expanding its tanker fleet at a cost which will approximate $13,000,000 by the middle of next year, and is furthering its plans for drilling and exploration work for additional expansion expected in the next two years.

New Laboratories

The announcement said the program also covered warehousing and shipping installations, new laboratories for petroleum technological advances, and modernization of marketing and service station facilities throughout the West.

Substantial manpower and equipment will be required in the company's domestic drilling and exploration program, Mr. Collier said. He said that Standard had spent more than $100,000,000 in drilling and exploration work in the past two years.

Further employment in the United States will be created by affiliated and subsidiary companies' program in the foreign field. A large part of the outlay in the foreign field will be for equipment bought in the United States, the announcement said.

Energetic programs are being planned in the foreign field—Saudi Arabia, Bahrein Island, Netherlands East Indies, Venezuela, Colombia, Alberta (Canada), and elsewhere. These operations, covering exploration, drilling, refinery construction and shipping facilities, will entail additional expenditures of many millions of dollars, the announcement said.

Gulf Independents Run 115,768 B/D in First Half September

Special to NPN

HOUSTON — Independent refineries on the Texas Gulf Coast for the first half of September reported runs to stills totaling 115,768 bbls. daily, which is at a rate of 78 per cent of rated capacity. A year ago these refineries in the Gulf Coast Refiners' Association processed 119,400 bbls. daily.

Stocks of all grades of gasoline and naphthas decreased during the first half of September by 49,172 bbls. and were reported at 1,565,388 bbls. A year ago total gasoline stocks were 1,387,318 bbls. while the stock pile two years ago was 1,708,673 bbls.

Aviation gasoline stocks Sept. 15 were 681,313 bbls., indicating a decrease of 122,998 bbls. from 804,311 bbls. on Sept. 1.

Automotive gasoline stocks considered alone were 588,954 bbls. on Sept. 15, showing an increase since Sept. 1 of 21,775 bbls. This indicates continued low inventory of this product. A year ago automotive gasoline stocks were 386,829 bbls.

Stocks of various grades of naphtha increased 52,051 bbls., from 243,070 bbls. on Sept. 1 to 295,121 bbls. on Sept. 15. A large portion of this naphtha is earmarked for butadiene operations.

Kerosine stocks at 169,476 bbls. on Sept. 15 indicate an increase of 73,103 bbls. during the period. Diesel gas oil stocks Sept. 15 were 474,985 bbls., reflecting an increase of 109,156 bbls. Stocks of No. 5 fuel oil increased 131,674 bbls. to 278,690 bbls. and Bunker C fuel oil increased 101,600 bbls to 361,947 bbls. on Sept. 15.

Stocks of all products in the plants of the GCRA group were reported at 3,732,371 bbls. on Sept. 15.

No Synthetic Fuels, Nitrogens Seen For Germans Under Plan

NPN News Bureau

NEW YORK—The German people are to have no opportunity to develop synthetic fuels—to world-conquering potentialities again.

First on the five-point program for strict control of German industry, formulated by the National Engineers Committee on the basis studies made for a year by 35 leading technological experts, calls for prohibition of synthetic fixation of nitrogen and prohibition of synthetic liquid fuel production.

The other three essential controls are prohibition of aluminum production, prohibition of atomic energy development or use, and limiting steel and steel-manufacturing capacity.

Eliminate War Potential

The purpose would be to avoid creating an economic vacuum in Germany, but at the same time to eliminate the war-making potential. Control of nitrogen eliminates Germany's munitions; control of synthetic liquid fuels immobilizes any German striking force.

The synthetic nitrogen control plan provides:

1. Destruction or removal of any remaining equipment for building plants; 2. Limiting chemical nitrogen production to by-products of the steel industry, plus 200,000 short tons as cyanamide per year; 3. All synthetic processes for hydrogenation of coal or hydrocarbon oils and for production of synthetic ammonia or methanol and other processes for producing fixed nitrogen by low pressure methods be eliminated.

Concerning synthetic fuels, the plan provides simply:

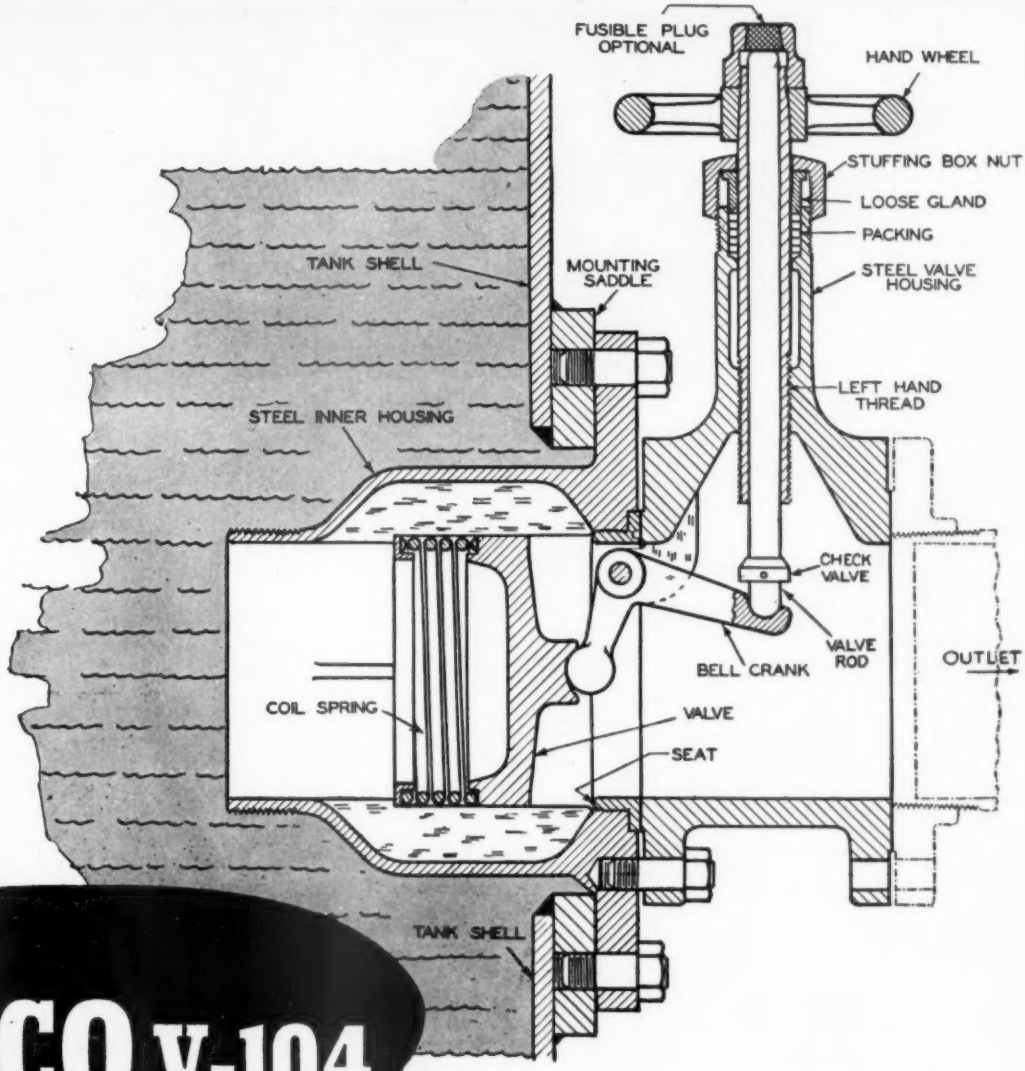
"It is recommended that Germany's synthetic fuel industry be entirely eliminated. It would be unwise to allow any part of the industry to exist as this would tend to maintain Germany's knowledge and technique of manufacture."

Bjorksten Laboratories Add Space for New Research

NPN News Bureau

CHICAGO—Dr. J. Bjorksten has announced that Bjorksten Laboratories has leased 1000 square feet of space in a fireproof building at 13791 South Avenue 0, Chicago, for new research assignments which have materialized since V-J day.

Through the past year, Bjorksten Laboratories has been working on rubber fillers, plastics, anti-corrosives and metal machining chemicals, carbon removers, and organic synthetic compounds for special purposes.



OCECO V-104
Internal Tank Valve

OCECO V-104 Internal Tank Valves safeguard the contents of liquid storage tanks against "run-off" in event of line breakage. They permit the flow to be shut off to make repairs or alterations in the line, and can be closed either manually—or automatically through the melting of the fusible plug—to prevent the tank contents from feeding a fire.

As illustrated in the diagram above, the valve is mounted on a saddle, which is welded to the tank shell. Turning the hand wheel to the left forces the valve rod downward. This actuates the bell crank, pushing the valve inward, putting the spring under compression — and permitting the fluid to pass outward. Reversing the hand wheel releases pressure on the spring, which reseats the valve, stopping the flow. The fusible plug, furnished when desired, melts at critical temperature, releasing the valve rod and cutting off the flow automatically in case of fire.

Oceco V-104 Internal Tank Valves are easy to install. Since the working parts are mostly within the tank, they are protected from all but the coldest weather. The valves have steel bodies, valve rods and bell cranks. Furnished with bronze or stainless steel trim, with or without the fusible plug. 4″, 6″, 8″ and 10″ sizes are standard. Others on special order.

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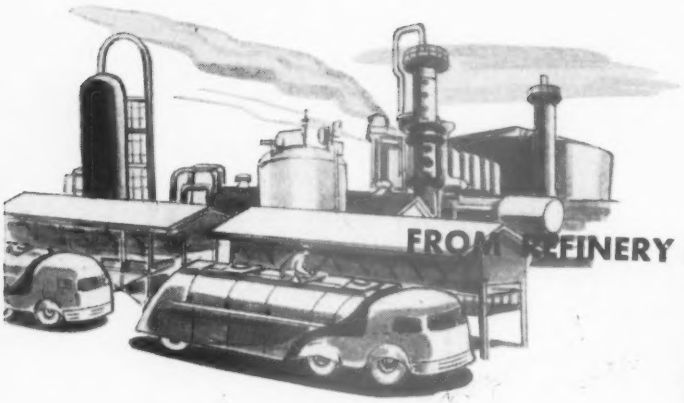

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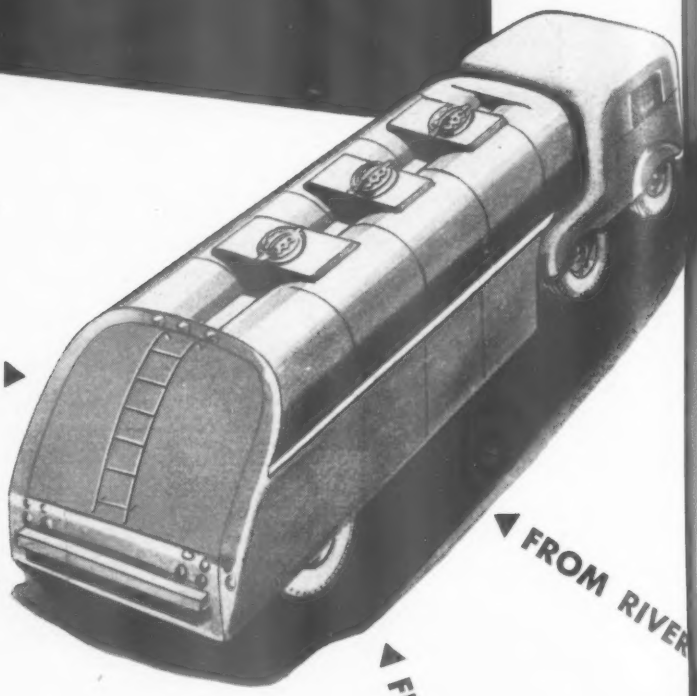

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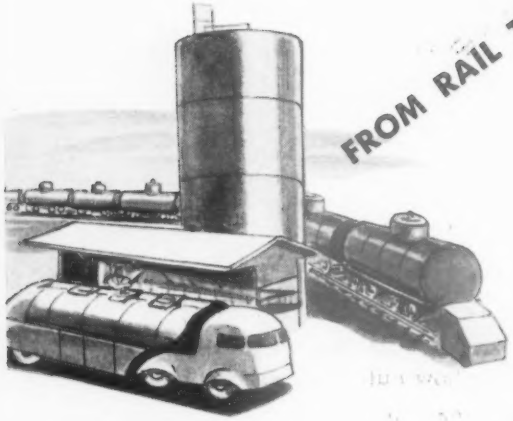
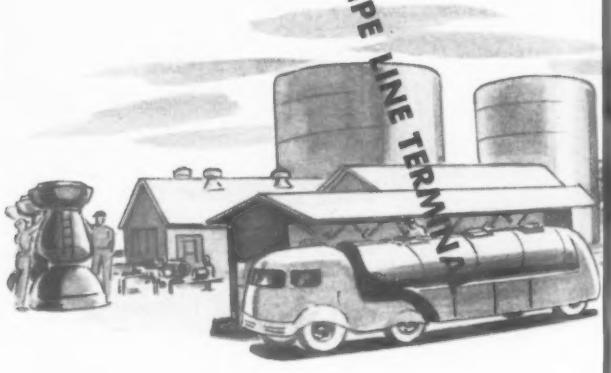
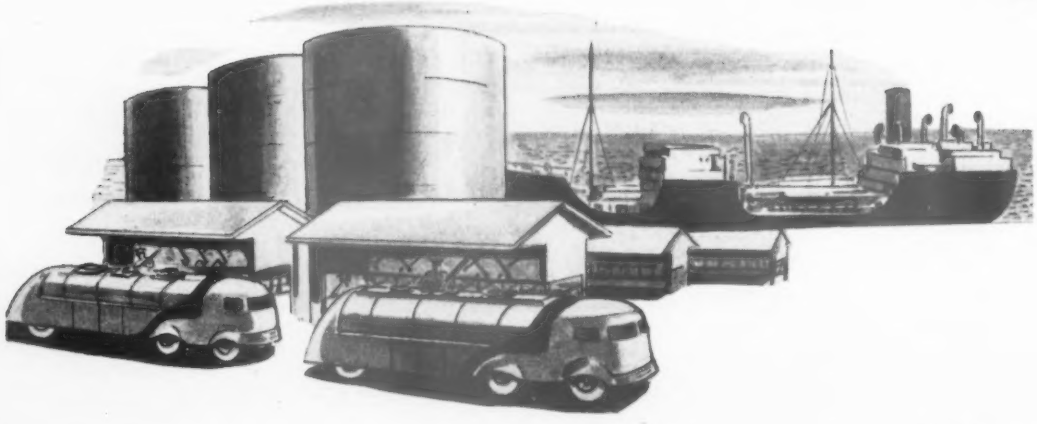
FROM RAIL TERMINAL ▶

◀ FROM PIPE LINE TERMINAL

FROM OCEAN TERMINAL ▶







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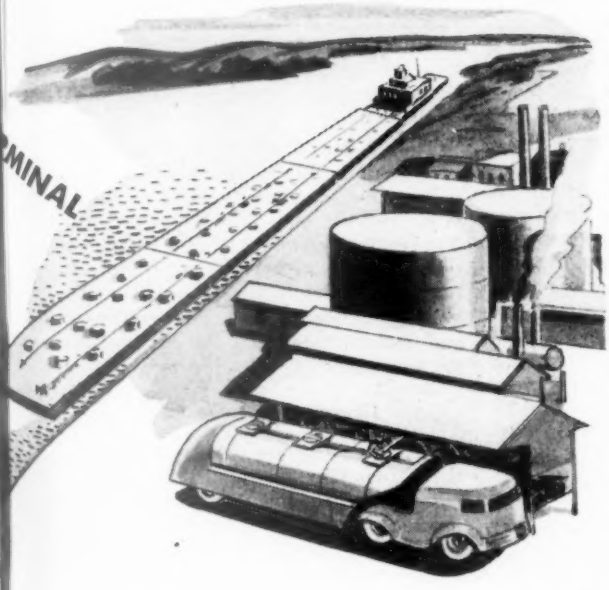

Butler-Built Safety Transports blazed the trail in dispersal hauling—proved its lower-cost-per-mile economy. Many miles were added to the practical range of highway transportation under the emergency of war. Stemming from their wider use are many other distribution efficiencies. Stepped up Butler production facilities can rapidly equip you to cash in on these advantages. Send the coupon NOW.

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New Oil Prospects Mapped In Michigan Peninsula

NPN News Bureau

WASHINGTON—Possibilities of finding additional oil and gas in rock formations of the Dundee and Rogers City areas, in the northern and eastern parts of Michigan's southern peninsula, are shown on a map issued last week by Geological Survey.

Entitled "Lithology and Thickness of the Dundee Formation and the Rogers City Limestone in the Michigan Basin," by George V. Cohee and Lloyd B. Underwood, it has been issued as Preliminary Map 38 of the Oil and Gas Investigations series. Copies may be purchased from Director of Geological Survey, Washington 25, D. C., and from Geological Survey Division, State Department of Conservation, Lansing 13, Mich., at 40 cents each.

More oil has been produced from formations of Middle Devonian age such as are found in the Dundee and Rogers City formation than from rocks of any other age in Michigan, Survey Director William E. Wrather said, and the latest study suggests several areas where further exploration by drilling is warranted.

14 More Crude Oil Pools Get 20-35 cent per Bbl Increases

Special to NPN

WASHINGTON — Fourteen more crude oil pools have been granted increases ranging from 20 to 35 cents per bbl., effective Sept. 1, under the stripper well premium payment plan.

Pools affected, and the amount of increase per bbl.:

Arkansas: Garland City, 33 cents; California: Torrance "34", 20 cents; Illinois: Boos North, 20 cents; Clay City West (McClosky), 20 cents; Maple Grove East, 35 cents; Kansas: Beaumont North, Roxberger, Jobes and Kraus, all 35 cents; Louisiana: Lake Barre, 35 cents; New Mexico: Barber, 27 cents; P. C. A., 35 cents; Salt Lake, 26c.; Texas: Sand Flat (Paluxy) 35 cents.

The increases are set forth in Amendment 7 to order 37 under RMPR 436.

Witnesses Hit Low-rate Territories, Rule By Federal Agencies at FPC Gas Hearings

NPN News Bureau

KANSAS CITY—The Federal Power Commission concluded this phase of its investigation into the natural gas industry last week, recessing until Oct. 9 when the next hearing will be held in Oklahoma City.

Before Commissioners Claude L. Draper, Nelson Lee Smith and Marvin Farrington, examiner, appeared some 15 witnesses representing Missouri and adjoining states and various companies affected by the production, distribution and inter-state transportation of natural gas in this area.

From Kansas' Corporation Commission came a protest against low rates, one important feature of concluding sessions. Missouri likewise was represented by a resolution protesting shipment of gas across her borders for use in a distant state to the detriment of Missouri.

These were highlights; again, in several statements made before the FPC, the idea of divided state and federal control was assailed, most witnesses preferring state regulation, although the controversy did not reach the same intensity it did in the sessions the week before.

Testimony during the last four days, dealt widely with the individual problems affecting gas distribution and consumption in the area but a great deal of other information was forthcoming affecting the future of the industry itself—how the marketing of natural gas can be improved, how the smaller producer can be aided, the serving of distant markets rather than adjacent areas, and control over the "end use" of gas.

Feared Restriction

A highlight of the testimony was the expressed fear of Milton M. Kinsey, president of the St. Louis Board of Public Service, over "the growing tendency to suggest the restriction or prohibition against the exportation of natural gas." Said Mr. Kinsey:

"In this category is also the substitute suggestion for the enactment of severance taxes which would have a similar final result. . . . It would seem that a provincial policy on the part of one state which is the producer of a natural resource would tend to endanger retaliatory action by other states who produce other natural resources."

Referring to the present situation in St. Louis, where a Mississippi River Fuel Corp. pipeline furnishes straight natural to 14 industrial concerns and natural gas to the Laclede Gas Light Co. which mixes it with manufactured gas to serve the other industries as well as domestic consumers, Mr. Kinsey pointed out:

"There would then be a situation where control over the 'end use' of gas and the possibility of revising the Mississippi-Laclede contract would leave Mississippi with its freedom from regulation securing a large percentage of the available dump and interruptible business, thereby preventing Laclede from earning an advantageous load factor, which, in turn would result in higher average gate rate costs for domestic gas and the existence of an unregulated utility business leading to the possibility of discrimination as between similar customers."

States Rights "Echo"

An echo of the dispute which flared in the hearing the week before when vigorous opposition was opposed to any invasion of state's rights by the FPC came in Mr. Kinsey's concluding remark that:

"We would prefer state regulation because we do not believe divided responsibility of the state commission and other industrial sales in the same city under the jurisdiction of a federal commission would be the most desirable arrangement."

One unusual feature of the concluding four sessions of the hearing here was a recess taken by the commission to permit the FPC commissioners and their staff to make a weekend tour of the gas fields in Kansas, whose toll of exhaustion in areas heavily-dependent upon them has been introduced into earlier sessions.

They departed after hearing testimony by Benjamin Miller, New York City consultant, representing the state of Kansas who decried the feasibility of the Fischer-Tropsch method for producing gasoline from natural gas at a competitive price unless it (the method) is considerably improved. Labor, equipment and maintenance costs for this method are extremely high, he pointed out.

Discussed Raw Material

J. C. Hawthorne, chemical engineer of the Kansas City Testing Laboratory, discussed the economics and feasibility of natural gas as an industrial raw material to develop chemical industries in the area of production.

L. B. Taylor, conservation engineer of the Kansas Corporation Commission augmented his earlier testimony on the physical waste in Kansas oilfields, asserting that the situation is now good as a result of state regulatory action.

From the Kansas Commission immediately afterward came a resolution, presented by Richard B. McEntire, chairman, pointing out that:

"The present price at which a major portion of the Kansas gas production is being sold is below the intrinsic value thereof and is not yielding a return commensurate to the true value of the product, which situation is unfair to the landowner and producer owning such production and is detrimental to the economic welfare of the state as a whole.

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and further hinders and impedes exploration for additional reserves.

"(That) it is the considered judgment of this commission that the exploitation of this resource of the state was, in the first instance, the result of a desire on the part of producers for quick profits by making the sales on the sole basis of a low price and unlimited production without regard to the prevention of waste or the protection of correlative rights; that the policy of establishing a rate base upon the production property of transmission companies based upon original cost thereof has the effect of making permanent the inequities and evils in the current depressed price."

Asked Fair Prices

The resolution also asked that fair prices be set in development of new territories, or else urged that where fair prices could not be arranged, the territory not be opened.

Mr. McEntire added that the new freight rate structure allowed by the Kansas Corp. Commission will give the state a great opportunity to advance; he believed Kansas reserves adequate.

He said he did not know "how far the FPC can go" in rectifying its action in adopting the original cost policy but declared "unless steps are taken it will be difficult to obtain as great a degree of conservation as is desired, and increased prices for gas."

The following day a statement from Missouri, signed by that state's Public Service Commission head, was presented by Glen K. Gilcrest, PSC engineer. It read:

"It is the position of the State of Missouri, speaking by and through its Public Service Commission, that natural gas should be made available to the people and businesses in this state in quantities sufficient to serve every demand for the use of natural gas.

"Since the State of Missouri is principally a consuming state but adjacent to the producing area, this state is opposed to the transportation of natural gas through this state for use beyond its borders if that use .... will curtail .... the supply .... available for use in this state."

Orphan Producers Hurt

A statement that "the Hugoton field in Kansas "is being strangled by monopoly by the big companies and that they are draining this field to the detriment of us orphan producers," was read into the record by E. O. Monnett, counsel for Helmerick and Payne, producers there.

Henry Keplinger, Tulsa Petroleum engineer, urged a program of ratable taking of gas from any common source of supply under which a uniform price would be paid, which, he contended would give the producers and royalty owners their fair share.

Texas Puts Emergency Clamp on Crude Output; 400,000 B/D Cut to Meet Strike Wave

Special to NPN

AUSTIN, Tex.—Faced with a rapidly increasing stockpile of crude, the Texas Railroad Commission has put through an emergency proration order slashing Texas production days in October from 21 to 12.

The order, announced in the wake of the wave of strikes that has tied up most of the major refineries on the Texas Gulf Coast, will cut Texas output by some 400,000 b/d, Commission engineers estimated. This is in addition to the slash of 207,000 b/d that had been announced in the original October order. If the order stands throughout the month, the state's oil wells will have an allowable of about 1,385,000 b/d, which is about the same level as prewar days. This will be a drop in production of nearly a million b/d from the peak production of 2,345,000 b/d authorized by the Commission in August.

Cause of the drastic action was "refinery shutdowns, pipeline proration and unequal withdrawals," Col. Ernest O. Thompson, member of the Commission, said.

"There is no need in letting oil pile up on the ground, wasting and unwanted by anyone.

"This emergency is caused by the fact that some pipelines are taking oil and others are refusing to take it because they have no place to run the oil. This makes for unfair and unratable takings from wells within the same fields and works unfairly, as between the various fields of the state.

"It is hoped that the allowable under this order will meet the greatly reduced demand for crude. We had previously reduced the state's oil production 395,000 bbls., effective Sept. 1. Then by recent order we reduced the output by 207,000 bbls Oct. 1.

"But on account of the shutdown of the various refineries, it seems necessary to put into effect immediately a further cut of 400,000 b/d during the refinery shutdown," Col. Thompson stated.

Will Meet Independent Needs

The order brought immediate howls of anguish from the small independent refiners who were having no labor troubles and needed a continuous supply of crude. Their fears were put to rest by both Commissioner Olin Culberson and Beauford Jester. Mr. Jester pointed out that any refiner needing more crude could request a special hearing of the Commission, which could be granted under law within 10 days, and his crude needs would be taken care of by special order.

The *Fort Worth Star-Telegram* made a poll of independent producers and reported that they were nearly unanimously in favor of the drastic cut, and that some were for closing down the state's wells completely until the storage situation clears up.

"If the refineries are unable to operate and process the oil, they see no reason to continue to produce, building up storage they feel will be wielded against them in the future—probably not in the too distant future, provided the strikes end and the majors find themselves well supplied with crude oil stocks," the newspaper commented, and went on to say:

"Oil men have to remember no further back than 1939 to realize the fate in store for them if this should happen ....

"At that time, when one major attempted to raise product prices in order to warrant the then going price of crude, the majority of the others failed to string along and a 20-cent per bbl. cut resulted.

"Major dominated companies were responsible for the 20-cent slash and independents are fearful the stage is being set for a reoccurrence."

"Straight Through" Slash

The Railroad Commission said the cut would be accomplished by slashing the number of producing days by nine on a "straight through" basis. Thus, fields which had been allotted the general 21 production days were cut to 12; those with 17 original production days were cut to eight, and so on. Fields originally exempt from shutdown days for engineering reasons will continue to be exempt.

Commissioner Jester said he understood crude had been going to storage at a rate in excess of 400,000 b/d since the refinery strike began.

Under Texas law the Commission can make emergency orders, without a hearing, that will be effective for 15 days. It is presumed that if the strike situation has cleared up by the middle of October the order will be revoked or modified. If strikes are still going on the emergency order can be re-issued.

Stephens Drills Tennessee Well

Special to NPN

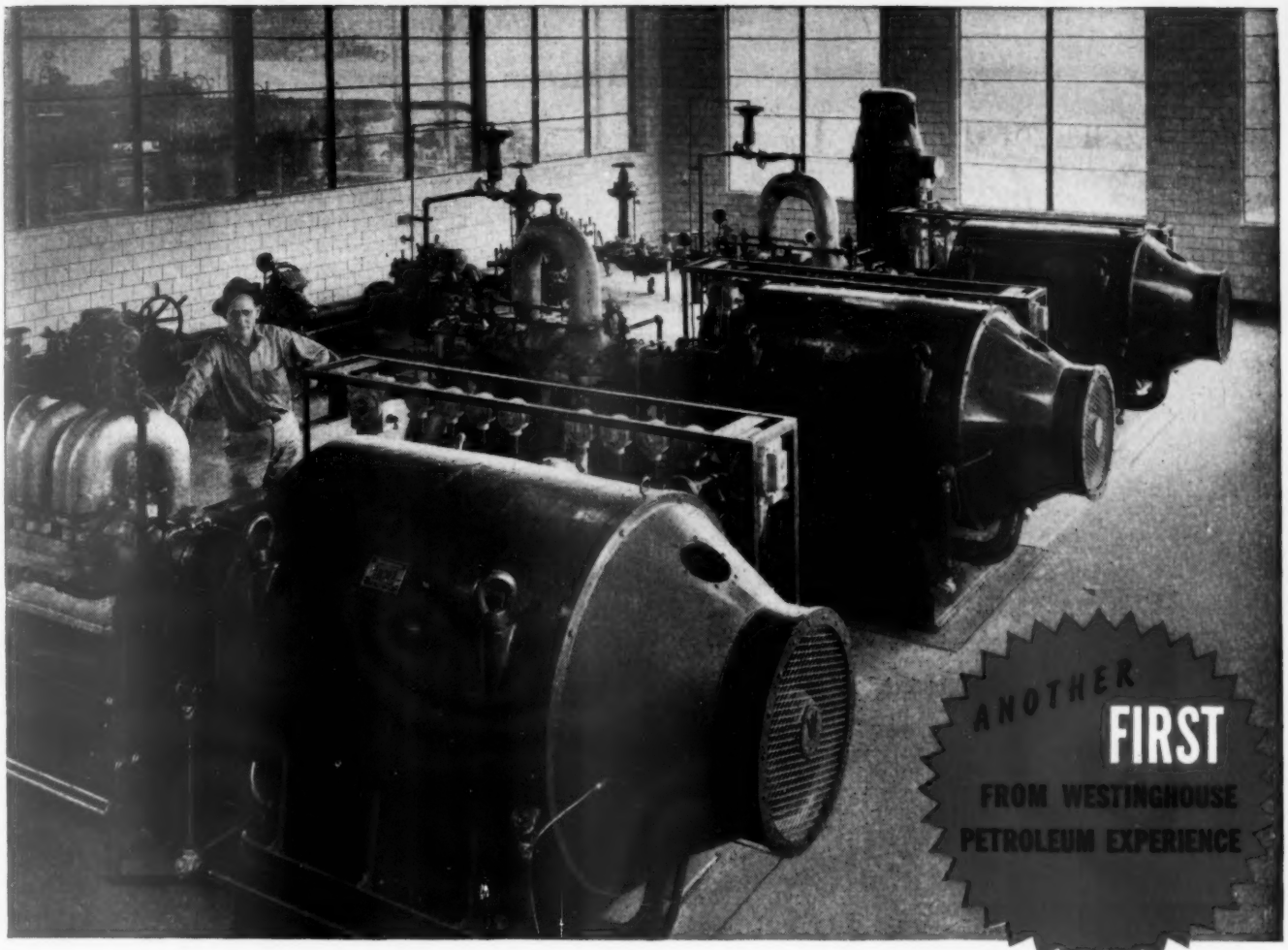
NASHVILLE, Tenn. — According to State Geologist H. B. Burwell, the Stephens Petroleum Company of Oklahoma City is drilling an oil well in McNairy County near the spot where the Battle of Shiloh was fought.

Mr. Burwell said the well is being drilled near Michie, where the Confederate Army established headquarters before the Battle of Shiloh.

Louisiana Allowable Trimmed

Special to NPN

BATON ROUGE—Louisiana Department of Conservation has set total crude allowable for October at 393,064 b/d, a decrease from September allowable of 10,876 bbl. Allowable was split between North and South Louisiana pools in amounts of 72,403 and 320,661 bbls., respectively.



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Return of Tankers to Owners To Be Discussed By WSA Oct. 4

NPN News Bureau

WASHINGTON — Early return to their former owners of all American-flag tankers requisitioned during the war was scheduled for discussion at a meeting of United Maritime Executive Board here Oct. 4, War Shipping Administration announced. At the same time, WSA rate experts continued calculations for reduced tanker rates, to be effective Dec. 1.

Original agreement of principles of the United Maritime Authority, of which UMEB is executive agency, stated that UMA would remain in existence for six months after termination of the war. Whether this period is to be reduced and all requisitioned tankers and other vessels returned to owners before that time, will be discussed at the meeting.

Serving as chairman of opening session, which will be attended by representatives of U. S., United Kingdom, Netherlands, Norway and France, will be Vice Adm. Emory S. Land, USN (Ret.), WSA Administrator and American member of the board. Attending later sessions will be representatives of member and associate member nations, the latter being Belgium, Canada, Greece, Poland, Australia, India, New Zealand, Union of South Africa, Brazil, Sweden, Chile and Denmark.

Maritime Commission Says 700 Tankers Built in 5-Year Period

NPN News Bureau

WASHINGTON — Seven hundred tankers of all types, of 10,747,000 dead weight tons, were constructed for U. S. Maritime Commission and for private use from July 1, 1940 through July 31, 1945, the commission disclosed today.

Breakdown on tanker production was given as follows:

	Number	DWT
July 1, 1940-Dec. 31, 1941	15	148,000
1942	62	999,000
1943	252	3,481,000
1944	229	3,739,000
Jan. through July, 1945	120	1,954,000
Totals	700	10,747,000

ODT Counselor Urges End of Interstate Truck Barriers

NPN News Bureau

WASHINGTON—Elimination of interstate trade barriers is a "must" if commercial trucking is to take its proper place in the over-all transportation service, Maj. Joseph E. Keller, ODT's adviser on state barriers, told the American Trucking Assn. at its annual meeting last week.

With ODT's highway transport duties as a war agency nearly concluded, Maj. Keller stressed that responsibility for removing state barriers now falls on other groups.

"It will be their solemn obligation," he added, "to work out a program of federal-state co-operation which will assure the removal of all interstate trade barriers so that commercial motor transport may go forward to fulfill its important function in the postwar period."

Container Shipping Plant Being Built In S. America

Special to NPN

RIO DE JANEIRO, BRAZIL—Construction has begun on a new plant in the Cordovil section here for the manufacture of steel shipping containers for the petroleum, alcohol, paint and vegetable oil industries in Brazil.

The operation, to be known as Rheem & Cia., will be managed by Rheem Manufacturing Co. of Brazil, Inc., a Delaware corporation. Rheem will have a 70% interest, the remainder being held by two Brazilians, Dr. Euvaldo Lodi and Dr. Heiter S. Bergallo. Dr. Bergallo is president of Empresa Nacional De Petroleo, operator of one of the largest chains of gasoline stations in Brazil.

Equipment for the plant is crated and ready for shipment from the United States and it is expected that the plant will be in full operation by March 1, 1946.

Disney Message to FPC Defends Policy of Gas Exportation

NPN Staff Special

KANSAS CITY—Wesley E. Disney, counsel for Independent Natural Gas Association of America, in a telegram to Federal Power Commission in Washington has urged that issuance or withholding of a certificate of necessity to Panhandle Eastern Pipe Line Co. for export of natural gas to Canada, should "not be prejudiced because of exportation alone."

Mr. Disney explained that his participation in the FPC inquiry into natural gas here prevented his appearance in Washington on the same day to present I.N.G.A.A.'s position on the pipeline company's behalf. "The I.N.G.A.A.," he said, "is convinced that known gas reserves of over 140 trillion cu. ft. warrant its sale in any market available, and that such sales will promote conservation of natural gas."

Progress Note: Your Cars Are Getting Better All The Time

NPN News Bureau

DETROIT — The Automobile Manufacturers Association says modern cars are giving customers five times as much value per dollar as those made 15 to 20 years earlier. The cars going off the road in recent years traveled an average of 81,000 compared with 21,750 miles of those retired in 1925.

COMING MEETINGS

OCTOBER

Indiana Independent Petroleum Assn., Hotel Severin, Indianapolis, Oct. 10-11.

Virginia Petroleum Jobbers Assn., Patrick Henry Hotel, Roanoke, Oct. 11 (tentative).

California Natural Gasoline Assn., Biltmore Hotel, Los Angeles, Oct. 12.

National Dixie Distributors Inc., Chicago, Oct. 15 (tentative).

Independent Petroleum Assn. of America, Oct. 14-15-16-17, Mayo Hotel, Tulsa, Okla.

W. Va. Petroleum Assn. Oct. 17, Charleston (Exact location to be announced.)

American Gas Association, annual meeting, auditorium of the Engineering Societies Building, 29 West 39th Street, New York City, Oct. 24-25.

NOVEMBER

Arkansas Independent Oil Marketers Assn., Albert Pike Hotel, Little Rock, Nov. 8.

American Petroleum Institute, Nov. 12 to 15. Hotel Stevens, Chicago.

Independent Natural Gas Assn., Dallas (exact location to be announced), Nov. 26.

South Dakota Oil Men's Assn., fall convention, Watertown, S. D., Nov. 26-27. Tentative.

DECEMBER

Oil Dealers' Assn. of Arkansas, Hotel Marion, Little Rock, Dec. 4.

Nebraska Petroleum Marketers' Assn., Hotel Paxton, Omaha, Dec. 4, 5, 6.

Wisconsin Petroleum Marketers, Dec. 11-12.

Mid-Continent Oil & Gas Assn., annual board of directors meeting, Tulsa, Dec. 14 (tentative).

JANUARY

Northwest Petroleum Assn., Jan. 24-25, Nicollet Hotel, Minneapolis, Minn.

FEBRUARY

Kentucky Petroleum Marketers Assn., Louisville. (Place and date to be announced.)

Iowa Independent Oil Jobber's Assn., Hotel Ft. Des Moines, Des Moines, Feb. 26-27 (tentative).

Illinois Petroleum Marketers Assn., Peoria. (Exact date not yet set.)

APRIL

Natural Gasoline Assn. of America, annual convention, Baker Hotel, Dallas, Texas, April 17-18-19, 1946.

MAY

National Association of Corrosion Engineers, President Hotel, Kansas City., May 7, 8, and 9.

Independent Oilmen's '45 Meet Scheduled in Tulsa Oct. 14-17

NPN News Bureau

TULSA — A domestic oil industry capable of meeting every requirement of peacetime industry and the consuming public is the chief objective of the Independent Petroleum Association of America which holds its annual membership meeting here Oct. 14 to 17.

Highlight will be President Ralph T. Zook's report on the London conference seeking an international oil program.

W. G. Skelly of Skelly Oil Co. is general chairman. Gov. Robert S. Kerr will welcome delegates and a principal speaker will be C. S. Snodgrass, associate director Petroleum Administration for War's foreign division on "We Bombed the Nazis Out of Oil."

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* Check extinguisher handle—it should turn easily.
* Check extinguisher fluid —make sure it is full and free from foreign matter.
* Check pumping action— pump should work smoothly and not stick.

If in doubt replace with a genuine S-O-S Fire Guard with panic proof safety lock and patented Safety Phlare for your positive protection.

Truman Claims Continental Shelf Oil for U. S.; Increases Interior's Authority Over Resources

NPN News Bureau

WASHINGTON — President Truman this week issued two executive orders greatly increasing Interior Department's authority over actual and potential U. S. oil and gas resources, one of them setting aside for department's jurisdiction, pending legislative action, all resources of the continental shelf, beyond the nation's three-mile limit.

The other order transferred to Interior, from War Department, jurisdiction over oil, gas and other mineral deposits in Dupre Strip or Cut, Jefferson Parish, La., to prevent possible drainage of such deposits "by wells on adjacent lands in private ownership." The Federal government is entitled to 3/32 of all minerals produced in the strip, by agreement with Jefferson Parish, signed February 14, 1941, the President stated.

Mr. Truman said of the first proclamation, covering "continental shelf," that it "does not touch upon the question of Federal versus State control." This statement apparently was designed to avoid opposition of states sensitive about their tidelands rights, as were the sentences that followed:

From International Standpoint

"It (the proclamation) is concerned solely with establishing the jurisdiction of the United States from an international standpoint. It will, however, make possible the orderly development of an underwater area 750,000 square miles in extent. Generally, submerged land which is contiguous to the continent and which is covered by not more than 100 fathoms (600 ft.) of water is considered as the continental shelf."

Preceding the President's proclamation were more than three years of investigations concerning resources in the "shelf," conducted by Geological Survey, General Land Office, and the Bureau of Mines. These agencies issued a statement calling attention to the fact the present position of America's shore line "has no relationship to any underlying oil or other mineral deposits," because during geologic time, that line has at times been far inland from its present position.

Description of America's continental shelf is given by Interior officials as follows:

"The continental shelf on the east coast of the United States from Cape Hatteras north ranges from 60 to 250 miles in width. South to Florida it is from 40 to 60 miles wide, although near Miami it is reduced to about 20 miles in width. Along the coast of the Gulf of Mexico the shelf is quite wide and that part of it contiguous to U. S. territory has an area of some 149,000 sq. mi.

"Along the Pacific coast of the United States proper," Interior continues, "the shelf is more narrow, averaging approximately 25 miles in width and varying in width from one mile to as many as 50. Off Alaska the shelf widens considerably and under the waters of the Bering Sea extends for several hundred miles."

The U. S. continental shelf is smaller than shelves in some other parts of the world, Interior points out. These shelves reach their greatest extent in Arctic areas, some parts of Asia, and the southernmost portions of South America. Continent with smallest submerged area, on the other hand, is Africa.

Texts of President Truman's proclamation and executive order, giving Interior authority over mineral resources, including oil and gas, in the U. S. continental shelf—at least until legislative action is taken—are as follows:

PROCLAMATION

"Whereas the Government of the United States of America, aware of the long range world-wide need for new sources of petroleum and other minerals, holds the view that efforts to discover and make available new supplies of these resources should be encouraged; and

"Whereas its competent experts are of the opinion that such resources underlie many parts of the continental shelf off the coasts of the United States of America, and that with modern technological progress their utilization is already practicable or will become so at an early date; and

"Whereas recognized jurisdiction over these resources is required in the interest of their conservation and prudent utilization when and as development is undertaken; and

"Whereas it is the view of the Government of the United States that the exercise of jurisdiction over the natural resources of the subsoil and sea bed of the continental shelf by the contiguous nation is reasonable and just, since the effectiveness of measures to utilize or conserve these resources would be contingent upon cooperation and protection from the shore, since the continental shelf may be regarded as an extension of the land-mass of the coastal nation and thus naturally appurtenant to it, since these resources frequently form a seaward extension of a pool or deposit lying within the territory, and since self-protection compels the coastal nation to keep close watch over activities off its shores which are of the nature necessary for utilization of these resources;

"Now, therefore, I, Harry S. Truman, President of the United States of America, do hereby proclaim the following policy of the United States of America with respect to the natural resources of the subsoil and sea bed of the continental shelf.

"Having concern for the urgency of conserving and prudently utilizing its natural resources, the Government of the United States regards the natural resources of the subsoil and sea bed of the continental shelf beneath the high seas but contiguous to the coasts of the United States as appertaining to the United States, subject to its jurisdiction and control. In cases where the continental shelf extends to the shores of another State, or is shared with an adjacent State, the boundary shall be determined by the United States and the State concerned in accordance with equitable principles. The character as high seas of the waters above the continental shelf and the right to their free and unimpeded navigation are in no way thus affected.

EXECUTIVE ORDER

"By virtue of and pursuant to the authority vested in me as President of the United States, it is ordered that the natural resources of the subsoil and sea bed of the continental shelf beneath the high seas but contiguous to the coasts of the United States declared this day by proclamation to appertain to the United States and to be subject to its jurisdiction and control, be and they are hereby reserved, set aside, and placed under the jurisdiction and control of the Secretary of the Interior for administrative purposes, pending the enactment of legislation in regard thereto. Neither this Order nor the aforesaid proclamation shall be deemed to affect the determination by legislation or judicial decree of any issues between the United States and the several states, relating to the ownership or control of the subsoil and sea bed of the continental shelf within or outside of the three-mile limit."

Work on New Carthage 'Gas' Plant To Start Soon

Special to NPN

CARTHAGE, Texas — Work is expected to start in a few days on the $3,000,000 high pressure gasoline plant four miles west of here by The Chicago Corporation in the Big Carthage gas-distillate pool.

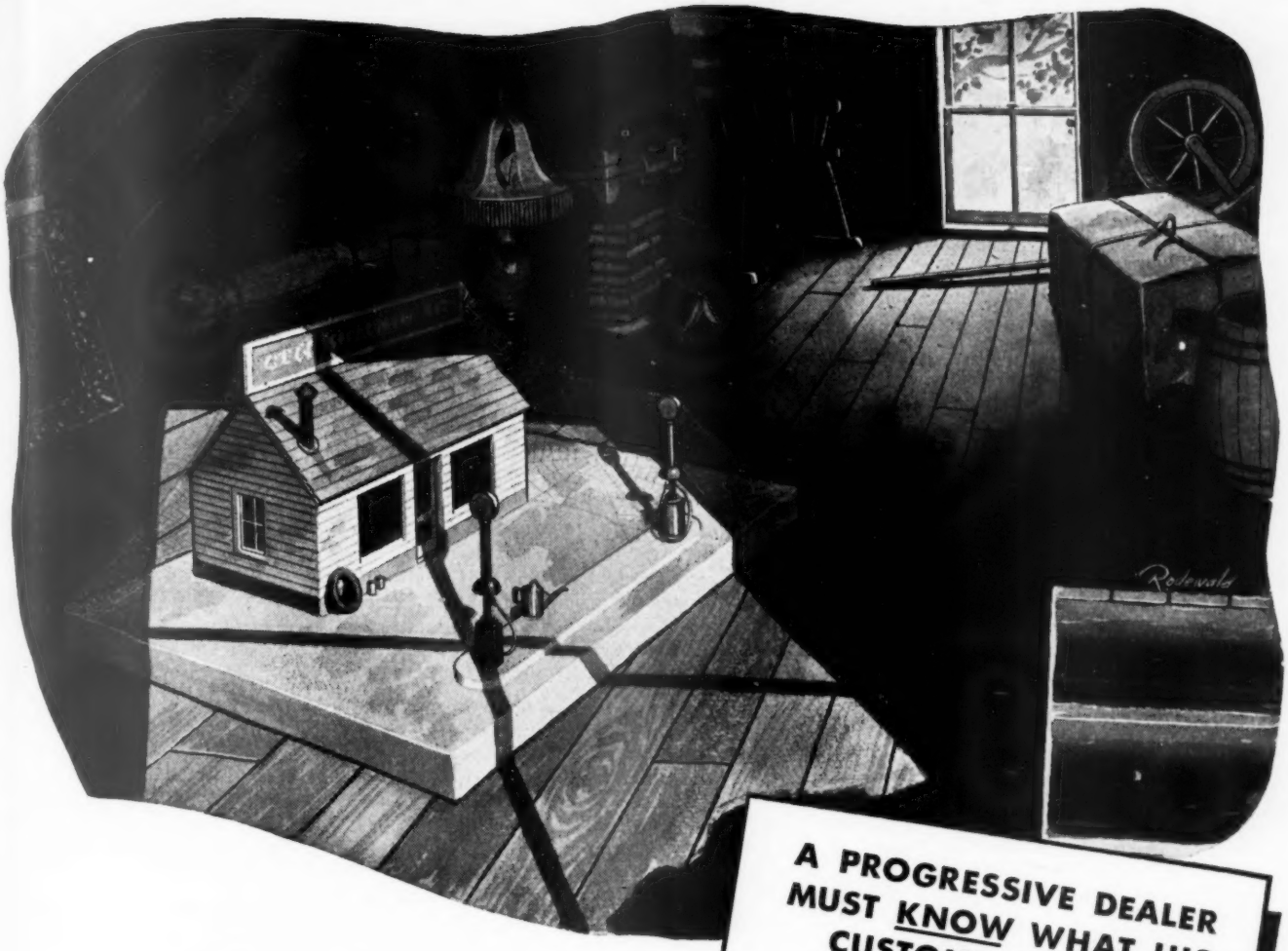
H. K. Greenleaf, executive vice-president of Z. C. Ambrose Co., in charge of plant operations, said the plant is expected to be in operation sometime next year. The construction contract has been let to the Stearns-Rogers Construction Co. and the site of the plant has already been cleared.

Mr. Greenleaf said the plant will be capable of producing high octane gasoline, will have stripping equipment and a complete lead blending unit. Butane will be produced as well as propane and I.T.G., a mixture of butane and propane.

The plant tank farm will provide storage for a 30-day period. There will be six 5000-bbl. tanks as well as several 10,000 and 20,000-bbl. tanks.

Mr. Greenleaf said separators also are to be installed and the United Gas Co. will lay a 24-inch line to plant to take care of the residue gas.

Two large generators will provide power for the camp site and project. Water wells will be drilled.



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SHELL OIL COMPANY, Incorporated

SHELL

Oil Agreement Good For Both Nations, Ralph Zook Asserts

LONDON (Reuters) — Ralph. T. Zook, president of the Independent Petroleum Assn., of America, feels that the British-American oil agreement is a "good thing" for both countries.

"It has my wholehearted approval and support," he stated.

Zook, in London as a member of the advisory group of the American delegation to the conference, made the following statement in a special interview for National Petroleum News:

"The agreement was negotiated in atmospheres of the greatest cordiality and understanding. The fact that complete agreement was reached in less than a week is an indication of the sincere desire by both parties to reach an understanding. It has none of the ambiguities of the previous agreement, and I do not believe it is possible to read anything into it that is not there. Both countries know, without a doubt, that with the exception of equal opportunity and mutual respect for acquired rights, it deals only with oil in international trade.

"However, to be doubly sure, there are specific statements that it does not apply to the domestic oil industry in either country, nor does it deal with imports of petroleum. These aspects are definitely excluded.

World Oil Surplus

"Oil produced anywhere in the world affects the producer of oil in the United States. There is now a world oil surplus, developed mainly for war purposes, that must be fitted into the world market in an orderly manner, unless there be a world oilwar which, I am sure, no one wants to see come about. Such a situation would in the long run be harmful both to the producer and the consumer.

"This agreement provides the vehicle which can bring about that order, so necessary to a healthy oil industry.

"The commission to be set up by the agreement will be entirely advisory. Compliance with any of its recommendations will be voluntary. It is based on the time-proven principle that a difference of opinion can be fought out or talked out, and that the latter is the best method.

"If special legislation is required to permit compliance by those who desire to follow the recommendations of the commission, I hope congress will see fit to enact such legislation.

Shows Cooperation

"The development and execution of this agreement will be an outstanding example of industry and government working together. The Interior and State Departments cooperated with one another and with industry in bringing about what I believe to be complete understanding. Industry representatives were fully consulted during these negotiations, and their recommendations were given full and proper consideration.

"I hope that the United States Senate will give an early ratification so that the commission can be set up and start functioning. No further action by Britain is required."

° ° °

By Sidney Gampell
Reuters Financial Editor

LONDON—The real "trade" in the Anglo-American oil agreement seems to be a completely free hand for United States domestic production in return for a completely free hand for Britain's imports, observers here believe.

Few people in the City (London's financial district) who have read it are inclined to regard the agreement as negative and it may prove a good omen both for multilateral oil agreement and for other wider questions outstanding between Britain and the United States.

The agreement is more concerned to uphold than surrender sovereignty not only of both countries but of their respective oil industries. Neither government is obliged to accept any proposal by the Anglo-American Oil Commission or to impose such a proposal upon its oil industry even if the government itself does accept it.

This above all—complete freedom from international interference—is what the United States independent oil producers wanted and why they insisted on last year's agreement being revised. The official communique frankly says that opposition in the United States Senate was "based largely upon domestic considerations." The new agreement makes it crystal clear that the Anglo-American Oil Commission will be purly advisory —which may well prove a good thing.

Britain gets a reciprocal concession on imports which is what Britain above all wanted. The exclusion of each country's domestic petroleum industry would not of itself mean reciprocity for Britain because, of course, the United States produces nearly all whereas Britain produces hardly any of its oil requirements. But the British government gets a free hand to regulate oil importation into Britain and the colonies.

British Minister of Fuel Emanuel Shinwell remarked that in discussions on "sterling and dollar issues" British representatives received certain satisfactory assurances from United States official representatives. Shinwell said the United States expressed willingness not only to allow Britain to import "sterling oil", but also to allow other Middle Eastern oil to be sold in sterling.

It is of primary importance to Britain whether Middle Eastern oil, by whomever developed, shall be sold in sterling or dollars. The Middle East, with its estimated 3,000,000,000 or 4,000,000,000 tons of untapped oil reserves, is a huge potential source of sterling currency. Thrown into the sterling scale it could redress the world's currency balance. Thrown into the dollar scale, Britons cannot see how it could fail to aggravate the world's existing acute dollar famine.

Leases Lands North of Seattle

Special to NPN

SAN FRANCISCO — Pacific Northwest exploration by Standard Oil Co. of California has resulted in leases on 25 square miles of lands in Whatcom County, Washington, north of Seattle.

National Petroleum News Ownership Statement

Statement of the ownership, management, circulation, etc., required by the Act of Congress of August 24, 1912, and March 3, 1933, of National Petroleum News, published weekly at Cleveland, Ohio, for October 1, 1945, State of Ohio, County of Cuyahoga.

Before me, a notary public in and for the State and County aforesaid, personally appeared A. E. Kraft, who, having been duly sworn according to law, deposes and says that she is the business manager of the National Petroleum News and that the following is, to the best of her knowledge and belief, a true statement of the ownership, management, etc., of the aforesaid publication for the date shown in the above caption required by the Act of August 24, 1912, as amended by the Act of March 3, 1933, embodied in section 537, Postal Laws and Regulations, printed on the reverse of this form, to-wit:

1. That the names and addresses of the publisher, editor, and business managers are: Publisher, The National Petroleum Publishing Company, Cleveland, Ohio; editor, Warren C. Platt, Cleveland, Ohio; and business manager, A. E. Kraft, Cleveland, Ohio.

2. That the owners are: The National Petroleum Publishing Co., Cleveland, Ohio; Warren C. Platt, Cleveland, Ohio; Bess H. Platt, Cleveland, Ohio; M. P. Boulton, Cleveland, Ohio; E. P. Maison, Springfield, Ohio; A. E. Kraft, Cleveland, Ohio.

3. That the known bondholders, mortgagees, and other security holders owning or holding 1 per cent or more of the total amount of bonds, mortgages, other securities are None.

4. That the two paragraphs next above, giving the names of the owners, stockholders, and security holders, if any, contain not only the list of stockholders and security holders as they appear upon the books of the company, but also, in cases where the stockholder or security holders appear upon the books of the company as trustees or in any other fiduciary relation, the names of the person or corporation for whom each trustee is acting, is given; also that the said two paragraphs contain statements embracing affiants' full knowledge and belief as to the circumstances and conditions under which stockholders and security holders who do not appear upon the books of the company as trustees, hold stock and securities in a capacity other than that of a bona fide owner and this affiant has no reason to believe that any other person, association, or corporation has any interest direct or indirect in the said stock, bonds or other securities than as so stated by her.

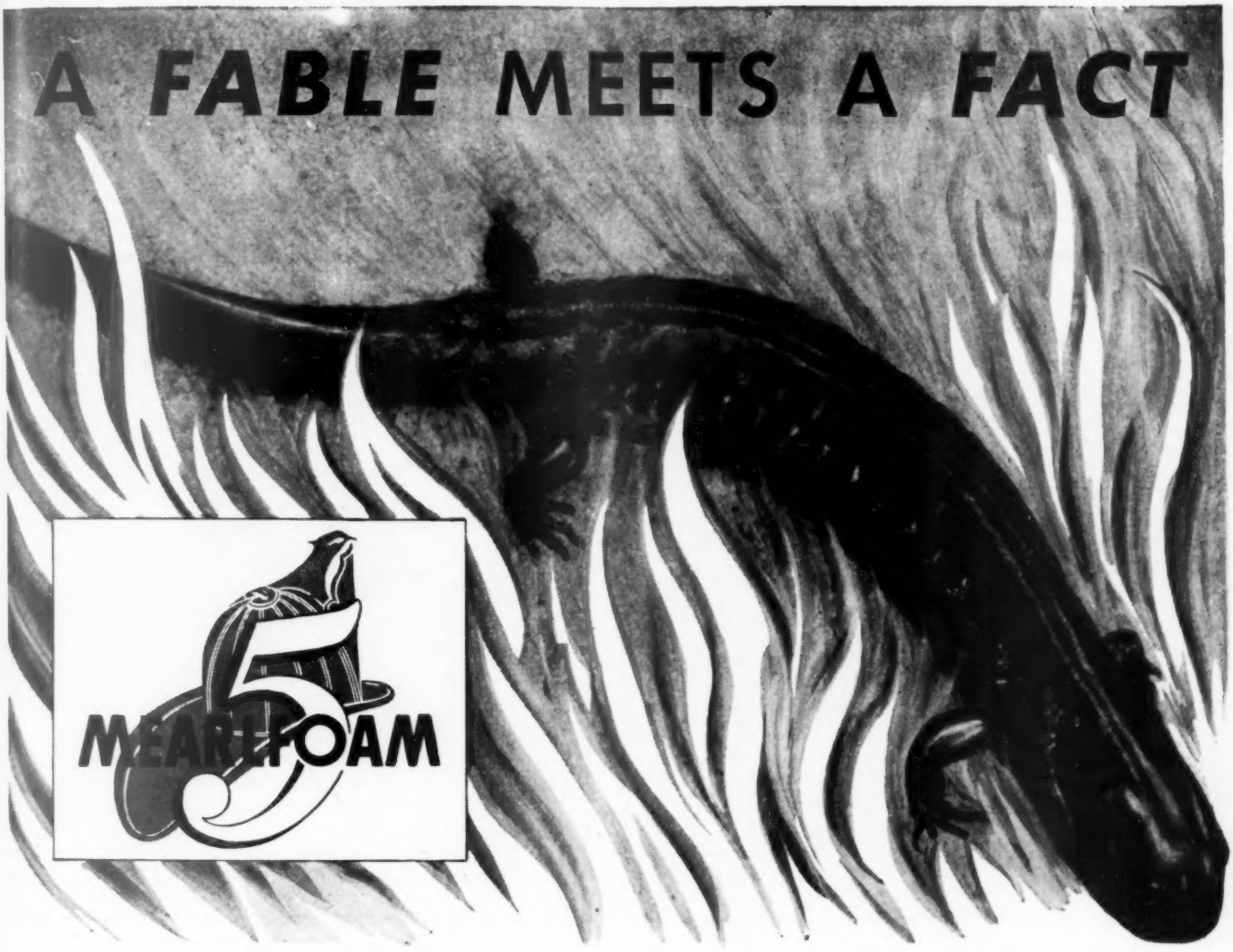
5. That the average number of copies of each issue of this publication sold or distributed, through the mails or otherwise to paid subscribers during the six months preceding the date shown above is (This information is required from daily publications only).

(Signed) A. E. KRAFT,
Business Manager

Sworn to and subscribed before me this 26th day of September, 1945.

(Signed) R. W. COLEMAN,
Notary Public

(My commission expires Dec. 26, 1947.)



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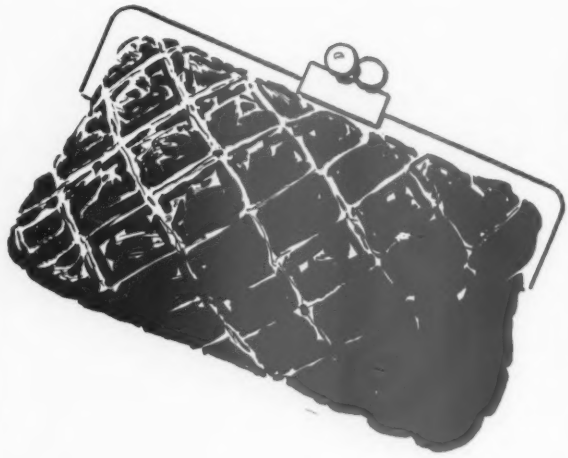

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COMPLIANCE SERVICE ON OIL REGULATIONS

Digest of Regulations Issued Weekly Regarding Oil and Oil Equipment

Index of Week's Oil Orders

(September 22-29, 1945)

PAW—Petroleum Administration for War
PAO 12, Revocation—Restrictions on materials for petroleum marketing abandoned
Petroleum Directive 59, Am. 4—Termination of Dist. 1 pooling provisions
OPA—Office of Price Administration
Rev. SR 11, Am. 63—Storage and handling of surplus property exempt from price control
MPR 88, Am. 33—Omissions and errors in recent East Coast price changes corrected
RMPR 436, Am. 18—Changes in crude and residue gas ceilings
WPB—War Production Board
Pri. Reg. 29, Interp. 1—Effect of AA ratings after 9-30
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Digest of Week's Oil Orders

Petroleum Administration for War

RESTRICTIONS ABANDONED ON MATERIALS FOR PETROLEUM MARKETING — PAO 12, Revocation — Issued 9-28, effective 10-15.

TERMINATION OF DISTRICT ONE POOLING PROVISIONS — Directive 59, Am. 4 to 12-1-43 version — PAW scheduling and designation of shipments of petroleum products into District 1 is abandoned, effective 10-1, along with its allocation of these supplies among East Coast primary suppliers. The provisions added by Am. 4 set up the necessary machinery for bringing this supply and distribution program to an orderly conclusion. An accounting method for original suppliers' adjustment among themselves of any allocation inequalities is outlined. Any supplier who fails to accept title by October 10 to any quantity of product allocated to him forfeits the product, which then remains the property of the supplier against whom the assignment was issued. No appeals may be filed after 10-10-45. Issued 9-18, filed 9-25, effective 10-1.

Office of Price Administration

STORAGE AND HANDLING OF SURPLUS PROPERTY EXEMPT FROM PRICE CONTROL — Rev. SR 11, Am. 63—Storage and handling of property declared to be surplus in accordance with Surplus Property Act of 1944, and services related thereto, including management services, when performed for RFC pursuant to a storage facility operation contract, or plan site storage agreement, are exempt from price control. Issued 9-27, effective 10-2.

OMISSIONS AND ERRORS IN RECENT EAST COAST PRICE CHANGES CORRECTED —MPR 88, Am. 33—In changing East Coast ceilings at the war's end to reflect changes in transportation conditions into the area, OPA was obliged to act hastily, and several errors occurred, which are corrected by Am. 33, issued 9-21, effective 9-1, the effective date of Am. 32. Heavy fuel oils sold as gas enrichment oils at New Haven are granted a 10c increase, and gasoline of 70-74 octane priced under Article VIII is granted a .125c per gal. increase, except on tank wagon and drum deliveries.

CHANGES IN CRUDE AND RESIDUE GAS CEILINGS — RMPR 436, Am. 18 — Increases ranging from 5c to 94c bbl. are granted four crude pools: the Cow Run Sand, Ohio, Lewisville, Ark., Horse Creek Field, Wyo., and Quealy Dome Field, Wyo. Adami and Munson Fields, Texas, are given a 10c reduction. Uniform ceilings are established for residue gas produced in the Texas Panhandle Area when sold for use in the manufacture of channel carbon black. Prices average 2.75c per M cu. ft. for sour, and 3.25c for sweet residue gas, depending upon the B.T.U. content of the gas. Issued 9-25, effective 10-1.

War Production Board

EFFECT OF AA RATINGS AFTER 9-30—Pri. Reg. 29, Interp. 1—After 9-30-45 AA ratings are ineffective and must be disregarded by suppliers. Even those orders (except on textiles) scheduled for delivery before 9-30, but delayed, must now be treated as unrated. Issued 9-24.

INVENTORY RULES—Pri. Reg. 32 as am. 9-17-45—If the inventory limits applying to any material are made more restrictive, whether by a change in Table 1 (materials subject to specific inventory provisions) or otherwise, any person affected must immediately cancel, reduce, or defer any order for the material to the extent that the scheduled delivery would result in an inventory greater than permitted by the new restriction and other applicable provisions of this regulation. Carbon and alloy steel, copper, electric motors, and rubber are among the listings on Table 1. Among the exempted materials and products listed in Table 3 are steel and brass pipe fittings, and steel and iron valves.

Reconstruction Finance Corporation

FAITHFUL ACCOUNTING BONDS — RFC Letter to Applicants under Rev. Reg. 1—Applicants for petroleum compensatory adjustments may reduce or terminate these bonds, filed to secure payment of 100% of claims, following preliminary examination, by having the principal surety give 30 days' written notice on behalf of all sureties. Issued 9-20.

CHANGES IN STRIPPER WELL SUBSIDY LIST—Reg. 7, Am. 6—To conform Schedule "A" of RFC Reg. 7 to the recently issued Am. 7 to Order 37 to RMPR 436, 14 additions are made to the subsidy list, listing wells in Ark., Calif., Ill., Kans., La., New Mex., and Tex. Issued 9-20, effective 9-1.

Department of Labor

FINDING IN DISPUTE INVOLVING PHILLIPS WORKERS—WLD 101—The Secretary of Labor certifies that the labor dispute involving various locals of the International Brotherhood of Teamsters (Case No. S-2609) and certain firms engaged in transporting petroleum products in Chicago, is one concerning transportation of petroleum products contracted for in the prosecution of the war, within the meaning of the War Labor Disputes Act. Issued 9-20.

Tank Makers May Obtain Individual Price Ceilings

NPN News Bureau

WASHINGTON — Manufacturers of butane gas tanks who are covered by RMPR 136 may obtain ceiling prices on an individual basis, OPA announced last week, in move to provide quick relief for manufacturers of goods that may not be reconversion products on an industry-wide basis but that are likely to meet reconversion standards of a large number of manufacturers.

Effective Oct. 3, manufacturers with annual sales of more than $200,000 may apply to OPA district offices for price increases to cover their 1941 costs, adjusted for legal increases in their labor and material costs.

OPA then will add an industry profit factor, based on half the industry's peacetime profit margin, and manufacturers may sell goods at the new prices as soon as they receive their adjustment notice from OPA.

Manufacturers with annual sales of less than $200,000 may figure their own ceiling prices, based on manufacturer's current costs, or on legal increases in material and labor costs since 1941, plus

OIL-LAW-GRAM Service

Complete texts of all orders or amendments digested in oil orders can be had from Platt's Oil-LAW-Gram, 1213 West 3rd street, Cleveland 13, Ohio. Minimum charge single copies $1. Copies of these texts are always in stock but large orders can be promptly filled by reprinting as plates and stencils are also kept.

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Due care and judgment have been taken in preparing and publishing these digests and in reproducing the original texts but the publisher does not warrant their absolute legal completeness nor accuracy. Important decisions by the reader should be made only after careful study of complete texts.

CODE: AO—Administrative Order; CMP Controlled Materials Plan; D—Directive; FDO—Food Distribution Order; GMPR—General Maximum Price Regulation; GO—General Order; Interp.—Interpretation; L—Limitation Order; M—Conservation Order; MPR—Maximum Price Regulation; P—Preference Rating Order; PAO—Petroleum Administrative Order; Pri. Reg.—Priorities Regulation; Proc. Reg.—Procedural Regulation; PS—Price Schedule; RO—Ration Order; RPS—Revised Price Schedule; SO—Supplementary Order; SR—Supplementary Regulation.

his peacetime profit margin, or half the industry's average peacetime margin.

The manufacturer must then report his new price to the nearest OPA district office, after which he may sell at that ceiling unless he hears differently from OPA.

Action was taken in Amendment 4 to Service Order 118 and Amendment 5 to Service Order 119.

STRIKES SPREAD

(Continued from page 7)

O.W.I.U., said that if the strike spreads to the oil fields, workers will be allowed to remain on the job at marginal wells to prevent damage to the well by shutdowns.

Humble Oil Operates

The big Humble Oil and Refining Co. so far has escaped the wave of strikes and is continuing to run its refineries full blast. Humble is mostly represented by an independent union, although the C.I.O. has a contract at the Ingleside refinery. The independent union is asking the same 30% increase as the C.I.O. and negotiations are continuing. From Houston Humble management issued a statement that it was sticking by its original offer of a 15% raise and would go no higher.

In Houston the management of Crown Central issued a statement condemning the strike action, which it said was in violation of its contract with O.W.I.U.

Herbert S. Lane, vice-president of the company, quoted a contract with the union which he said reads: "It is agreed that there shall be no cessation of work through strikes or lockouts during the term of this agreement." He said the contract does not expire until Jan. 31, 1946.

"Our existing contract with the union provides for renegotiation with respect to wage rates on 30 days written notice by either party, and we are perfectly willing to abide by the spirit and letter of this agreement, and the union was so notified by letter Sept. 18, 1945.

"Good faith between the parties to this agreement is essential. We desire harmonious and friendly relations with our employes. This objective, which should animate both sides, is seriously threatened when union officials disregard the express terms of their contract and issue inaccurate and misleading statements. Crown Central should not be criticized for conforming to government directives and insisting upon compliance with a union contract made in good faith by the parties thereto."

Earlier the union had charged Crown Central with shutting down one plant in Houston, but the company pointed out this was a high-octane gasoline refinery owned by RFC, and the government cancelled this contract Aug. 15 and ordered the company to restrict maintenance and overtime work on this plant to a minimum. The contract was ended Sept. 14 and the government ordered that the unit be placed on a stand-by condition, with employes reduced accordingly.

Text of Schwellenbach Statement to Conferees

NPN News Bureau

WASHINGTON — Statement of Secretary of Labor Lewis B. Schwellenbach to the oil conferees Oct. 1, 1945:

As I told you Saturday, this is no ordinary strike. If it should be prolonged and extended, its results would put in jeopardy the very life blood of American economy. The supplying of gasoline and oil is essential. Lack of them will result in the shutting down of vital basic industries. Reconversion and employment would be impossible. They are necessary for the continued operation of our transportation systems. If this strike continues on into the winter, the people will be hungry and cold. Any prolonged delay in the settling of the strike would—as I pointed out Saturday—result in the delay of the return to this country of the troops which have been sent overseas. THIS STRIKE MUST BE SETTLED.

This conference has been in session for one week. I feel the time has come when it is my duty to submit a proposal. I do so with the realization that this proposal will not be tasteful to either side in the controversy we have been considering. I have reached my decision to make this proposal only after most careful consideration. I feel that I must make it if I am to perform my duty to protect the public interest of the people of the United States. I remind you that it is with the welfare of 130,000,000 American people that we here are dealing.

"No Real Progress"

I convened this meeting in Chicago last Tuesday. After three days it became apparent that the meeting in Chicago could not accomplish the purpose for which it was called. Thereupon, I asked you gentlemen here with the hope that it might be possible here to be of assistance to you in arriving at some mutually satisfactory settlement. The fact is that no progress has been made. Before last Tuesday, and indeed before the strike started, most of the companies involved had offered an increase in basic hourly wages of 15%. At the time of the starting of the strike, and of the opening of the meeting in Chicago, the union was demanding an increase in basic hourly wages of 30%.

It is true that there is a difference between the owners and the union as to the terminology involved in the percentages. The owners call it a "wage increase." The union calls its demand a "maintenance of take-home pay." Actually, however, the area of difference between the two is the 15% difference between the owners' offer and the union's demand.

During the last week there has been much discussion and many arguments in joint meetings, and in separate meetings. However, never at any time has there been any evidence of yielding on either side. There has been no collective bargaining. What has happened has been a collective refusal to bargain. The union has stuck to its 30% demand. The companies have refused to go above 15%. The conciliation panel has worked patiently in an effort to bring about collective bargaining. I am convinced the time has come frankly to recognize the futility of continunig this panel discussion.

4-Point Recommendation

Therefore, I have concluded that it is my responsibility to submit the following recommendations and to urge their acceptance by the operators on the one side, and the union on the other:

1. I am calling on the Union to request its members to return to work. I am calling on the managements in the oil industry to resume operations.

2. I am asking each company to endeavor to return to a 40-hour working schedule as soon as manpower availablity permits.

3. I am asking that when any plant of a company returns to a 40-hour week it will increase the basic pay rate by 15% or its equivalent.

4. I am asking the union on the one side, and the managements on the other, to agree to accept as final and binding the decision of an impartial arbitrator on the question of the difference between the offer made by management and the demands made by the union.

The decision of the arbitrator is to become effective as to each company as of the date that such company or plant returns to a 40-hour work week. If, prior to the commencement of hearings, any company shall have arrived at a settlement with the union on a collective bargaining basis, the parties so settling may withdraw from the arbitration. The decision of the arbitrator shall be handed down as soon as possible, but not later than December 1, 1945, unless by mutual consent the date is extended.

I assume that the parties will require time for consideration of this proposal and suggest that the chairman of the panel adjourn this meeting until 4 o'clock p. m., Oct. 2, 1945. At that time I will expect all the operators and the union to accept this proposal. Within twenty-four hours thereafter, I will make the appointment of an arbitrator.

Protection For Fall Field Work Asked by IPMA Secy.

Special to NPN

SPRINGFIELD, Ill.—In identical telegrams sent to President Truman and PAW Director Ickes on Sept. 27 G. A. Primm, executive secretary of the Illinois Petroleum Marketers Assn., emphasized the need for insuring continued manu-

PIERCED PLATE CAUSTIC WASH TOWER

... proves efficient for treating hydrocarbon with chemical solutions

A refinery in the South is using this 6 ft. diam. by 40 ft. pierced plate contacting tower in its debutanizer and splitter unit in place of the conventional packed column or orifice mixing column. This type of tower provides several advantages when used in connection with refinery operations associated with lube oil treating, gas recovery, catalytic and thermal cracking, alkylation and acid extraction. Some of the advantages are: Low pressure drop and low operating costs. Efficient, economical counter-current extraction. Avoidance of intensive mixing.

In this pierced plate tower, caustic soda enters at the top above the plates, flows down over the plates, and is drawn off at the bottom of the tower. The hydrocarbon is introduced into the tower below the bottom plate, and because of its lesser density, travels up through the heavy solution, being directed through the plates by inverted tiers. Space is provided in the top of the tower for separation of the light solution from the heavy solution. This tower is only one of many types which we design, build and erect for the petroleum industry. Write our nearest office, outlining your requirements.

NEW STRESS-RELIEVING EQUIPMENT AT CHICAGO

To further serve the petroleum industry, we are now erecting a stress-relieving furnace at our Chicago plant that will accommodate vessels up to 15 ft. in diam. by 83 ft. in length in a single charge. Structures longer than 83 ft. are stress-relieved in multiple heats. This new furnace will have a temperature range up to 2000°F.

CHICAGO BRIDGE & IRON COMPANY

Birmingham 1 ..... 1534 North Fiftieth Street
Houston 1 ..... 5618 Clinton Drive
Tulsa 3 ..... 1607 Hunt Building
New York 6 ..... 3345-165 Broadway Building
Cleveland 16 ..... 2206 Guildhall Building
Atlanta 3 ..... 2150 Healey Building
Plants in BIRMINGHAM, CHICAGO

Chicago 4 ..... 2125 McCormick Building
San Francisco 11 ..... 1260-22 Battery St. Building
Philadelphia 3 ..... 1614-1700 Walnut St. Building
Los Angeles 14 ..... 1422 Wm. Fox Building
Washington 4 ..... 703 Atlantic Building
Havana ..... Edificio Abreu 402
and GREENVILLE, PENNSYLVANIA

facture of gasoline for the farmers' fall field work.

The wires read:

"Present labor differences in oil industry causing acute situation in transportation and distribution to essential users in rural and suburban areas. Oil distribution is faced with inability to supply gasoline and other essential petroleum products to farmers now doing necessary field work to insure production of food for this country and abroad. Feel every effort should be made to adjust controversy on basis protecting essential users and their distributors.

"We urge you to use your executive powers to insure continued refining operations thus preventing the possible paralysis of our national transportation system and agricultural activities which would be a serious setback to our entire demobilization and reconversion program."

O. A. Knight Assails 'Fat And Rich' Oil Industry

Special to NPN

CHICAGO—A bitter attack on the oil industry was made last week by O. A. Knight, president of Oil Workers' International Union (C.I.O.) after a meeting of the union executive council.

Text of Mr. Knight's statement follows:

"The issue in the wage dispute between the oil companies and their workers affects the future of every American man, woman and child. It is fundamental to the welfare of the nation. It is this—shall the postwar living standards of the American people be cut and bring on another inevitable depression or shall they hold and move forward to share the increasing abundance that is available.

"At the very time that government points out that Americans must learn to live 50% better—must be able to buy 50% more—the oil industry chooses to cut the real earnings of its workers 30%. Wage cuts for workers mean reduced earnings for the storekeeper, the farmer, the doctor and teacher. They mean deflation, poverty and unemployment. They bring on idleness of both capital and labor. Without enough buyers, American industry can't sell. It stops.

"The union demand must be met to hold the purchasing power of the oil workers. During the war, with frozen wage rates and rising living costs and taxes, the oil workers, like others, only stayed above water by working overtime, and now with hours cut to 40 hours—his take home pay is slashed 30%. The very time that wages should be increasing to help build the nation's buying power they are being cut.

"The industry that is arrayed against its workers has become fat and rich with wartime profits. Between 1940 and 1944, years of tragedy and death, 18 large companies alone amassed over $2,320,000,000 in clear profits after taxes. This is equivalent to the pay of 3,000,000 army privates and apprentice seamen for one year with a half billion left over. Besides there are other millions in profits concealed in padded reserves, "special" wartime contingency funds, depreciation allowances and pension trusts for the management. And the industry is well fixed for the future. Besides paying them millions in postwar tax refunds, the government has guaranteed the industries profits for two postwar years.

"Against this wartime extortion, the companies offer their workers wage cuts. The 30% request of the union, if granted, will not buy the oil workers family an additional loaf of bread. It will simply protect the family from losing its present living standard.

"The union demand will hardly even touch the exorbitant profits of this industry. Savings due to the elimination of premium overtime pay, reduction in funded debt and extra millions available if surplus profit taxes are sheared or eliminated will cover the 30% demand of the workers.

"In addition labor costs in oil production are the lowest of any American industry. With output per man-hour rising 300% in 20 years equal to 15% each year, the total wages paid out to labor by the companies is increasingly a smaller part of the value of production.

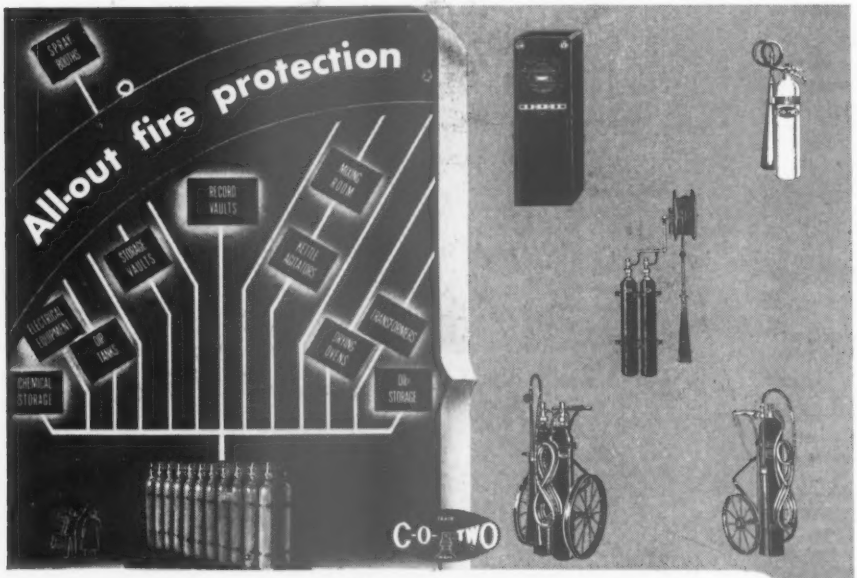
"Judge Vinson, when director of reconversion, said that full employment and prosperity for America is dependent on a general 50% rise in living standards.

"This Standard oil dominated industry, enriched and made powerful by the war, can not be allowed to spearhead a drive to reduce the earnings of the American people and not the groundwork for another depression. Every decent thinking American man and woman should support the oil workers."

° ° °

Knight issued the following statement at railroad station before leaving here for Washington:

"It should be definitely understood that the oil companies, and not the union, have been preventing supply of oil to essential services and the Army and Navy. In Port Arthur, Texas, the companies refused to provide oil to a Navy tanker while union workers were on the docks with specific instructions to load it. In Detroit, both the Socony-Vacuum, affiliate of Standard Oil, and Gulf refused to cooperate with the union in establishing emergency gas stations for essential services. The same has happened elsewhere. I have issued orders to our locals that they must make oil available for doctors, nurses, hospitals, fire and police department, public transportations and army and navy. No military or naval operations will be hindered for lack of oil if the companies will cooperate with our efforts to provide it, and no homeward service man will be delayed. Our present struggle against wage cuts is an effort to provide jobs with decent American earning levels for all veterans. We want to cooperate to bring them home."



PRODIGIOUS production for the war effort has put the spot-light on over-all, all-out fire protection for industry. Enterprising men know that some methods used to extinguish fires can cause as much damage to machinery and materials and consequent delay in the return to production, as the fire itself. They know, too, that carbon dioxide, the fastest non-damaging fire extinguishing agent, because of its terrific fire killing speed, has received acceptance by the Army, Navy, Maritime Commission and all industry producing vital materials for the war.

C-O-TWO smoke detecting and fire extinguishing systems may be arranged to protect one or a series of spaces from the same battery of cylinders by use of a separate direction valve for each space.

Materials handled or stored in any of the hazards suggested above can be extinguished with C-O-TWO portables, hose units or systems in seconds with a sub-zero blast of carbon-dioxide gas. C-O-TWO provides tomorrow's fire extinguishing equipment for today's fires.

C-O-TWO FIRE EQUIPMENT COMPANY

NEWARK 1 NEW JERSEY

Sales and Service in the Principal Cities of United States and Canada

AFFILIATED WITH PYRENE MANUFACTURING COMPANY

Pew Replies To Ickes' Cable On Strike Issue

Special to NPN

PHILADELPHIA—J. Howard Pew, president of Sun Oil Co., replying to cable sent by PAW Director Ickes, in which Mr. Ickes appealed for cooperation in settling the oil strike, said that Sun did not propose to subject its employes and their families to violence at the hands of lawless elements at Sun's Toledo refinery. This plant was closed, though the workers are not affiliated with the C.I.O.

Full text of Mr. Pew's telegram follows:

"Responding your telegram stating Army and Navy cannot afford losses in military petroleum production occasioned by issues between Labor and Management which have led to work stoppages. There are no issues between Labor and Management of the Sun Oil Co. which have led to any work stoppages. Our Toledo refinery, however, was forced to suspend operations last Thursday night when hundreds of men purporting to be members of the C.I.O. placed a picket line around the plant and through spokesmen informed company managers that no Sun Oil workers would be permitted to enter the refinery.

"As a matter of fact Sun Oil shift workers Thursday night by threat of force were prevented from entering the refinery and necessarily operations were suspended. On Friday morning spokesmen for the picketers announced they would not interfere with operation of the Government-owned butadiene plant and would not prevent Sun Oil Co.'s employes entering the refinery but stated that if any effort were made to operate other units or to make any shipments they would immediately prevent further entry into the refinery.

"All but five of Sun Oil's regular and day shift employes reported for work Friday morning, a far-below-normal absenteeism mark. Again Saturday, Sunday and Monday a full complement of Sun Oil employes reported for work. All plant employes have been assigned to maintenance work since Friday and gasoline production has not been resumed in face of threats by C.I.O. representatives that if such an effort is made picketers will stop further entry of employes into the plant.

"Workers of Sun Oil's Toledo refinery are not affiliated with the C.I.O. and have not been a party to the picketing of the Toledo Refinery. Nor have Sun Oil's Toledo employes made any demands on the management. Our employes, as evidenced by their reporting for work since Friday morning, are willing and ready to resume the production of gasoline and other petroleum products. So far the management does not feel justified in risking Sun Oil's employes and their families to violence at the hands of lawless elements by resuming operation of the refinery. Would appreciate your suggestions."

WOOD RIVER

QUALITY PRODUCTS AVAILABLE TO THE INDEPENDENT JOBBER

ETHYL and all grades of leaded and unleaded gasoline
TRACTOR FUEL — DIESEL FUEL
ASPHALT — KEROSENE
Numbers 1, 2, and 3, DOMESTIC FUEL OIL
RANGE OIL — INDUSTRIAL FUEL OIL

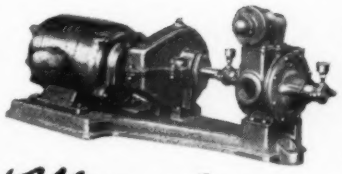
SALES OFFICES:

HARTFORD, ILLINOIS — Phone Wood River 4-4874 — P. O. Box 145
ST. PAUL, MINNESOTA — Phone De Soto 5533 — 1700 Stewart Avenue

HOME OFFICE:
WICHITA, KANSAS

WOOD RIVER OIL AND REFINING COMPANY, INC.

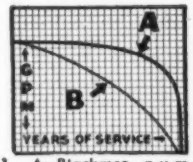
A PUMP YOU CAN TRUST Because



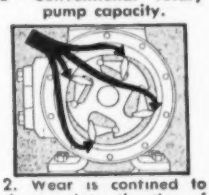
BLACKMER "BUCKET DESIGN" Means

SELF-ADJUSTMENT FOR WEAR... ECONOMY YOU NEVER EXPECTED

The drawings show you why—



1. A—Blackmer pump capacity. Note the long sustained efficiency. B—Conventional rotary pump capacity.



2. Wear is confined to these points; the tips of the buckets, which automatically compensate for wear.

3. This much of a bucket can wear away without affecting the capacity of the pump.

4. When finally worn out, the buckets are easily replaced (a 20-minute job) and the pump restored to normal capacity.

FOR HANDLING

GASOLINE CRUDE OIL	BUTANE FUEL OIL	LUBE OIL NAPHTHA

BULK STATION PUMPS	TRUCK PUMPS	HAND PUMPS
50 to 730 G.P.M.	35-50-90 G.P.M.	1½ to 25 G.P.M.
Single or twin	Double bearings	Barrel or tank

Write for Bulletin No. 102—Pumps for the Petroleum Industry

BLACKMER PUMP COMPANY
1880 Century Avenue — Grand Rapids 9, Michigan

SERVING THE PETROLEUM INDUSTRY FOR 40 YEARS

Market Reports

MIDWEST — Region began to feel the strikes during the past week. Supplies were short and all marketers and refiners reported that demands greatly exceeded supplies. Gasoline was unavailable and one marketer reported that regular gasoline in some cases was reduced from 75-octane to the war specifications of 70-72. All inventories are reported very low. As one refiner stated it: "We are running it right out of the stills and into trucks."

Refiners say that distress supplies of all products have vanished and that prices are right at the ceiling. One Michigan refiner said that he had no labor trouble but that he expected he might have trouble in obtaining crude in the near future.

Much cooler weather in the Midwest is expected to draw severely on present supplies of heating oils and most refiners believe there will be a shortage before the burning oil season is over.

All refiners and marketers say that this week will really start the hardship.

* * *

MIDCONTINENT — Central West Texas refiner reported quoting 6c on 73-75 oct. gasoline. No other quotation changes were reported during the week.

Refiners reported being "snowed under" with gasoline orders which they were unable to fill. Several in Kansas said they were trying to buy but having little luck. Brokers and industries are inquiring for heavy fuel, but little is available, according to reports. A few refiners remarked they were having difficulty getting tank cars. Demand for heating oils has increased but chief interest is still in gasoline.

Price of Grade 26-70 natural gasoline remained constant during the week with sales of six cars reported at 3.5c FOB Breckenridge, and eight cars at 4.5c FOB Group 3.

* * *

PENNSYLVANIA — Refiners in both the upper and lower fields said that all products were being closely held pending outbreak of strikes in areas. Although majority of refineries are not C.I.O. union, it was thought that sympathy strikes would occur. One refiner said that he was getting heavy demands for materials from Ohio dealers and could help out only to a small extent.

Neutrals were reported to be in tighter supply than ever by one refiner who said that he was oversold on product to the first of the year. Demands for all lubes are very strong, he said.

* * *

ATLANTIC COAST — New price ranges were effected for kerosine when supplier re-entered the market with prices of 5.8c at Boston and Providence, making new range of 5.7-5.8c at both points. Refiner previously quoting 5.2c for Diesel oil, shore plants, and $2.15 for Diesel oil, ship's bunkers, at Boston raised these quotations to 5.3c and $2.19 respectively.

New quotations were reported for gas house oil when supplier re-entered the market, posting 5.5c at Albany and 5.4c at Portland, Boston and Providence. The same supplier said he was re-entering the Diesel oil market (shore plants) posting price of 5.3c at Albany, Portland, Boston and Providence.

* * *

GULF COAST—Approximately 300,000 bbls. of housebrand motor gasoline and approximately 25,000 bbls. of unleaded 62-octane motor gasoline reported sold for export at prices of 5.75c and 5c for the two products respectively. One refiner reported withdrawing his price of 97c for Bunker "C" cargoes, leaving the flat price unchanged.

Many refiners said that all operations were at a standstill with no shipments being made due to strikes. Others said that business was normal.

* * *

CALIFORNIA—Although there was a threat of strike, refineries continued normal production during the week. Gasoline supply demands were being met promptly. No price changes were recorded.

N.P.N. Gasoline Index

	Dealer T.W.	Tank Car
	Cents Per Gal.	
Oct. 1	9.99	6.59
Month ago	10.34	6.72
Year ago	10.42	6.73

Dealer index is an average of "undivided" dealer prices, ex-tax, in 50 cities.

Tank car index is weighted average of following wholesale markets for regular-grade gasoline, FOB refineries or terminals: Okla., Mid-Western, W. Penna., Calif., N. Y. Harbor, Philadelphia, Jacksonville, Boston and Gulf Coast.

Summary of Daily Gasoline Prices (September 24 to October 1)

	Monday Oct. 1	Friday Sept. 28	Thursday Sept. 27	Wednesday Sept. 26	Tuesday Sept. 25
U. S. Motor (ASTM octane)					
78-80 octane Ethyl:					
Oklahoma	6.75 – 6.875	6.75 – 6.875	6.75 – 6.875	6.75 – 6.875	6.75 – 6.875
Mid-Western (Group 3 basis)	6.75	6.75	6.75	6.75	6.75
N. Tex. (For shpt. to Tex. & N. M. dest'ns.)	7	7	7	7	7
W. Tex. (For shpt. to Tex. & N. M. dest'ns.)	7 – 7.125	7 – 7.125	7 – 7.125	7 – 7.125	7 – 7.125
E. Tex. (Truck Tnsp.)	7	....	....	....	....
73-75 octane:					
Oklahoma	6	6	6	6	6
Mid-Western (Group 3 basis)	5.875– 6	5.875– 6	5.875– 6	5.875– 6	5.875– 6
N. Tex. (For shpt. to Tex. & N. M. dest'ns.)	6	6	6	6	6
W. Tex. (For shpt. to Tex. & N. M. dest'ns.)	6	6	6	6	6
E. Tex. (Truck Tnsp.)	6	....	....	....	....
63-66 octane:					
Oklahoma	5.625 (1)	5.625 (1)	5.625 (1)	5.625 (1)	5.625 (1)
Mid-Western (Group 3 basis)	5.625 (2)	5.625 (2)	5.625 (2)	5.625 (2)	5.625 (2)
N. Tex. (For shpt. to Tex. & N. M. dest'ns.)	5.625 (1)	5.625 (1)	5.625 (1)	5.625 (1)	5.625 (1)
W. Tex. (For shpt. to Tex. & N. M. dest'ns.)	5.625 (2)	5.625 (2)	5.625 (2)	5.625 (2)	5.625 (2)
E. Tex. (Truck Tnsp.)	....	....	....	....	....
60 octane & below:					
Oklahoma	5.25	5.25	5.25	5.25	5.25
Mid-Western (Group 3 basis)	5.2 – 5.25	5.2 – 5.25	5.2 – 5.25	5.2 – 5.25	5.2 – 5.25
N. Tex. (For shpt. to Tex. & N. M. dest'ns.)	5.2 – 5.25	5.2 – 5.25	5.2 – 5.25	5.2 – 5.25	5.2 – 5.25
W. Tex. (For shpt. to Tex. & N. M. dest'ns.)	5.25	5.25	5.25	5.25	5.25
E. Tex. (Truck Tnsp.)	5.25	....	....	....	....
Motor Gasoline, 73-75 oct.					
New York harbor	8	8	8	8	8
New York harbor, barges	7.9	7.9	7.9	7.9	7.9
Philadelphia district	8	8	8	8	8
Baltimore district	7.75	7.75	7.75	7.75	7.75
Motor Gasoline, 70-72 oct.					
New York harbor	....	....	....	....	....
New York harbor barges	....	....	....	....	....
Philadelphia district	....	....	....	....	....
Baltimore district	....	....	....	....	....
Motor Gasoline:					
Western Penna. Bradford-Warren:					
(a) "Q" Gasoline, Min. 74 Oct. (ASTM)	7.5–8.225 (a)	7.5–8.225(a)	7.5–8.225 (a)	7.5–8.225 (a)	7.5–8.225 (a)
Western Penna. Other Districts:					
"Q" Gasoline, Min. 74 Oct. (ASTM)	7.25	7.25	7.25	7.25	7.25
70 oct. (ASTM)	....	....	....	....	....

Note: Gasoline prices are as reported in each day's Platt's OILGRAM, Daily Oil Price Service.
(a) Highs and lows for Schedule D area, in MPR 88 and outside Schedule D area, respectively.

OIL PRICE SECTION ★ At Refineries and Terminals and by Tank Wagon

Prices herewith are reproduced from Platt's *OILGRAM* Daily Oil Price Service, associated with National Petroleum News, whose representatives in all *NPN-OILGRAM* offices devote their time exclusively to reporting oil industry prices everywhere.

Prices shown are actual sales prices, or quotations meaning sellers' general offers or posted prices; for current sales and shipment; for the business day or period stated; except Tank Wagon prices, prices are for bulk lots such as tank car and motor transport; barge or tanker cargo lot prices are identified; FOB refineries or terminals; in cents per gal. except where shown in bbls. of 42 gals.; ex all fees and taxes; for crude oil and its products lawfully produced and transported; reported as received by *OILGRAM* and National Petroleum News but not guaranteed; for subscribers' private use only and not for resale or distribution or publication. For further details of price conditions apply to any *NPN-OILGRAM* office or see back of any *OILGRAM* Price Service invoice.

For complete price service delivered daily from nearest *OILGRAM* publishing office, New York, Cleveland and Tulsa, address Platt's Price Service, Inc., 1213 W. 3rd St., Cleveland (13), Ohio. Annual subscription rate payable in advance $100 per year train mail and $112.50 per year air mail.

Refinery Prices

Gasoline —U. S. Motor (A S T M) except where otherwise specified.

Prices in Effect	October 1	Sept. 24
OKLAHOMA		
78-80 oct. Ethyl	6.75 – 6.875	6.75 – 6.875
73-75 oct.	6	6
63-66 oct.	5.625 (1)	5.625 (1)
60 oct. & below	5.25	5.25
MID-WESTERN (Group 3 basis)		
78-80 oct. Ethyl	6.75	6.75
73-75 oct.	5.875– 6	5.875– 6
63-66 oct.	5.625 (2)	5.625 (2)
60 oct. & below	5.2 – 5.25	5.2 – 5.25
N. TEX. (For shpt. to Tex. & N. M. dest'ns.)		
78-80 oct. Ethyl	7	7
73-75 oct.	6	6
63-66 oct.	5.625 (1)	5.625 (1)
60 oct. & below	5.2 – 5.25	5.2 – 5.25
W. TEX. (For shpt. to Tex. & N. M. dest'ns.)		
78-80 oct. Ethyl	7 – 7.125	7 – 7.125
73-75 oct.	6	6
63-66 oct.	5.625 (2)	5.625 (2)
60 oct. & below	5.25	5.25
CENT. W. TEX. (Prices to truck transports)		
78-80 oct.	7 (2)	6.875–7 (2)
73-75 oct.	6–6.125 (2)	5.875 (1)
67-69 oct.	....	....
62 oct. & below	5.25 (2)	5.25 (2)
73-74 oct.	6 (1)	6 (1)
KANSAS (For Kansas destinations only)		
78-80 oct. Ethyl	7.2 – 7.3	7.2 – 7.3
73-75 oct.	6.2 – 6.3	6.2 – 6.3
63-66 oct.	5.9 (2)	5.9 (2)
60 oct. & below	5.5	5.5
ARK. (For shipment to Ark. & La.)		
78-80 oct. Ethyl	7 (1)	7 (1)
73-75 oct.	6 (1)	6 (1)
62 oct.	....	....
60 oct. & below, unleaded	5.25 (1)	5.25 (1)
WESTERN PENNA. (Motor gasoline)		
Bradford-Warren:		
"Q" Gasoline Min. 74 Oct. (ASTM)	7.5–8.225 (a)	7.5–8.225 (a)
Other districts:		
"Q" Gasoline, Min. 75 oct. (ASTM)	7.25	7.25
70 oct. (ASTM)	....	....

(a) Highs and lows for Schedule D area, in MPR 88 and outside Schedule D area, respectively.

Prices in Effect	October 1	Sept. 24
CENTRAL MICHIGAN (FOB Central Mich. refinery group basis; for shpt. within Mich. may originate at plants outside Central group.)		
U.S. Motor: (Oct. ASTM):		
73-75 oct.	7.50 – 8.125	7.50 – 8.125
78-80 oct.	9-9.25 (2)	9-9.25 (2)
Str. run gasoline, excluding Detroit shpt.	6	6
OHIO (S. O. Ohio quotations for statewide delivery and subject to exceptions for local price disturbances).		
73-75 oct.	8.375	8.375
CALIFORNIA U.S. Motor:		
80-82 oct. (Ethyl)	8 – 8.5	8 – 8.5
74-75 oct.	7 – 7.5	7 – 7.5

Kerosine, & Gas Fuel Oils

Prices in Effect	October 1	Sept. 24
OKLAHOMA		
41-43 grav. w.w.	4.375	4.375
42-44 grav. w.w.	4.5	4.5
Range oil	4	4
No. 1 p.w.	3.875	3.875
No. 1 straw	....	....
No. 2 straw	3.625	3.625
No. 3 fuel	3.5	3.5
No. 6 fuel	$0.90–$0.97	$0.90–$0.97
U. G. I. Gas Oil	....	....
14-16 fuel	$0.97 (1)	$0.97 (1)
MID-WESTERN (Group 3 basis)		
41-43 grav. w.w.	4.375	4.375
42-44 grav. w.w.	4.5	4.5
Range Oil	4 –4.1	4 –4.1
No. 1 p.w.	3.875	3.875
No. 2 straw	3.625	3.625
No. 3	3.5(1)	3.5 (1)
No. 5	....	....
No. 6	$0.97 (1)	$0.97 (1)
N. TEX. (For shpt. to Tex. & N. M. dest'ns.)		
41-43 grav. w.w.	4.375	4.375
42-44 grav. w.w.	4.5 (1)	4.5 (1)
No. 1 p.w.	3.875 (1)	3.875 (1)
No. 6 fuel	$0.97 (1)	$0.97 (1)
W. TEX.		
No. 6 fuel	$0.97 (1)	$0.97 (1)
AMARILLO, TEX. (For shpt. to W. Okla. & Tex. differential territory.)		
42-44 grav. w.w.	4.5 (1)	4.5 (1)
KANSAS (For Kansas destinations only).		
41-43 grav. w.w.	No Price	No Price
42-44 grav. w.w.	4.7	4.7
No. 1 p.w.	4.1	4.1
No. 6 fuel	$1.02	$1.02
ARK. (For shipment to Ark. and La.)		
41-43 grav. w.w.	....	....
42-44 w.w. kero	4.5 (1)	4.5 (1)
No. 1	....	....
No. 2	3.625 (1)	3.625 (1)
No. 3 fuel	3.5 (1)	3.5 (1)
Tractor fuel, for shpt. to Ark. points only	5.125 (1)	5.125 (1)
Diesel fuel 52 & below	4 (1)	4 (1)
Diesel fuel 58 & above	4.25 (1)	4.25 (1)
WESTERN PENNA. *Bradford-Warren:*		
45 grav. w.w.	6.5 – 7.55	6.5 – 7.55
46 grav. w.w.	....	....
No. 1 fuel	6.5 (1)	6.5 (1)
No. 2 "	6.125-7.125(2&b)	6.125-7.125(2&b)
No. 3 "	6.25-7.25(1&b)	6.25-7.25(1&b)
36-40 gravity	6.25 (2&c)	6.25 (2&c)

(b) Highs and lows for Schedule D area, in MPR 88 and outside Schedule D area, respectively.
(c) Effective on and since Sept. 14.

Other districts:		
45 grav. w.w.	6.425	6.425
46 grav. w.w.	....	....
47 grav. w.w.	6.55 (2)	6.55 (2)
No. 1 fuel	6.175– 6.425	6.175– 6.425
No. 2 "	5.875	5.875
No. 3 "	5.875	5.875
36-40 grav. Pittsburgh dist. prices excluded	5.875	5.875
CENTRAL MICHIGAN (FOB Central Mich. refinery group basis for shpt. within Mich.; shpts. may originate at plants outside Central group.)		
46-49 gravity w.w.	5.8 – 6	5.8 – 6
P.W. Distillate	5.5	5.5
No. 3 gas. oil, Straw	5	5
U.G.I. gas oil	4.5	4.5
Fuel Oils (*Vis. at* 100).		
300-500 Vis	4.14	4.14
100-300 Vis	4.5	4.5
OHIO (S. O. quotations for statewide delivery)		
Kerosine	7	7

Prices in Effect	October 1	Sept. 24
CALIFORNIA		
40-43 grav. w.w.	7(1)	7(1)
San Joaquin Valley:		
Heavy fuel	$1.10 (2)	$1.10 (2)
Light fuel	$1.20 (1)	$1.20 (1)
Diesel fuel	4 (2)	4 (2)
Stove dist.	5 (2)	5 (2)
Los Angeles:		
Heavy fuel	$1.10 (2)	$1.10 (2)
Light fuel	$1.20 (1)	$1.20 (1)
Diesel fuel	3.25 – 4 (2)	3.25 – 4 (2)
Stove dist.	5 (1)	5 (1)
San Francisco:		
Heavy fuel	$1.15 (1)	$1.15 (1)
Light fuel	$1.25 (1)	$1.25 (1)
Diesel fuel	4.5 (1)	4.5 (1)
Stove dist.	5.5 (1)	5.5 (1)

NOTE: All above heavy fuels meet Pacific specification 400; light fuel, spec. 300; Diesel fuels, spec. 200; and stove distillate, spec. 100.

Lubricating Oils

Prices in Effect	October 1	Sept. 24
WESTERN PENNA. Prices are for sales made, or offers reliably reported, to jobbers & compounders only. Viscous Neutrals— *No. 3 col. Vis. at* 70°*F.*		
200 Vis. (180 at 100°) 420-425 fl.		
0 p.t.	38 (1)	38 (1)
10 p.t.	37 (1)	37 (1)
15 p.t.	36 (1)	36 (1)
25 p.t.	28–33	28–33
150 Vis. (143 at 100°) 400-405 fl.		
0 p.t.	36 (1)	36 (1)
10 p.t.	35 (1)	35 (1)
15 p.t.	34 (1)	34 (1)
25 p.t.	26–31	26–31

NOTE: Limited quantity neutrals available to regular trade.

Cylinder Stocks:		
Brt. stk., 145-155 *vis. at* 210°, 540-550 fl., *No. 3 col.*		
10 p.t.	30.5 (1)	30.5 (1)
15 p.t.	29.5 (1)	29.5 (1)
25 p.t.	25	25
600 S.R. filterable	15	15
650 S.R.	15.5	15.5
600 fl.	16	16
630 fl.	17	17

MID-CONTINENT (F. o. b. Tulsa)		
Neutral Oils (*Vis. at* 100° *F. to* 10 *P.P.*)		
Pale Oils:		
Vis. Color		
60-85—No. 2	7.5	7.5
86-110—No. 2	7.5	7.5
150—No. 3	11 –11.5	11 –11.5
180—No. 3	11.5 –15	11.5 –15
200—No. 3	12 –15	12 –15
250—No. 3	14 –16.5	14 –16.5
280—No. 3	15	15
300—No. 3	16 (2)	16(2)
Red Oils:		
180—No. 5	11.5 (1)	11.5 (1)
200—No. 5	12 (1)	12 (1)
280—No. 5	No Price	No Price
300—No. 5	16–17.5 (2)	16–17.5 (2)
Bright Stock—*Vis. at* 210°		
200 Vis. D	27 (1)	27 (1)
150-160 Vis. D: 0 to 10 p.p.	23	23
10 to 25 p.p.	22.5–23	22.5–23
25 to 40 p.p.	23 (1)	23 (1)
150-160 Vis. E	22 (1)	22 (1)
120 Vis. D: 0 to 10 p.p.	22 (2)	22 (2)
600 S.R. Dark Green	8.5 (1)	8.5 (1)
600 S.R. Olive Green	10-11 (2)	10-11 (2)
631 S.R.	....	....
Black Oil	....	....

SOUTH TEXAS (Neutral Oils)		
Pale Oils (*Vis. at* 100°*F.*)		
Vis. Color		
100 No. 1½-2½	6.5	6.5
200 No. 2-3	8.75	8.75
300 No. 2-3	9.25	9.25
500 No. 2½-3½	10	10
750 No. 3-4	10.25	10.25
1200 No. 3-4	10.375	10.375
2000 No. 4	10.5	10.5

(Continued on next page)

NOTE—Parenthetical figures after prices indicate number of companies quoting when less than three companies are quoting.

NOTICE—Owing to great demand, refiners generally limit quotations to regular customers and refuse bids, though higher, from others. Refiners' prices and sales shown; bids reported in market leads.

Refinery Prices (Continued)

Prices in Effect	Oct. 1	Sept. 24
Red Oils:		
100 No. 5-6	6.5 (2)	6.5 (2)
200 No. 5-6	8.75	8.75
300 No. 5-6	9.25	9.25
500 No. 5-6	10	10
750 No. 5-6	10.25	10.25
1200 No. 5-6	10.375	10.375
2000 No. 5-6	10.5	10.5

CHICAGO (From Mid-Continent p.l. crude.) Neutral oils *vis. at* 100° *F. 0 to* 10 *p.p.*

Pale Oils		
Vis. Color		
60-85—No. 2	9 (1)	9 (1)
86-110—No. 2	9.25 (1)	9.25 (1)
150—No. 3	12.5 (1)	12.5 (1)
180—No. 3	13 (1)	13 (1)
200—No. 3	13 (1)	13 (1)
250—No. 3	14 (1)	14 (1)
Red Oils:		
180—No. 5	13 (1)	13 (1)
200—No. 5	13 (1)	13 (1)
250—No. 5	14 (1)	14 (1)
280—No 5	15 (1)	15 (1)
300—No. 5	15.5 (1)	15.5 (1)

Note: Viscous oils, 15 to 30 p.p. are quoted 0.5c lower; 60-85 and 86-110 No. 2 non-viscous oils, 15 to 30 p.p., 0.25c lower.

Unfiltered Steam Refined (*Viscosity at* 210°)		
140	11.5 (1)	11.5 (1)
160	12.5 (1)	12.5 (1)
200	13.5 (1)	13.5 (1)
Bright stocks, 160 *vis. at* 210 *No.* 8 *color:*		
0 to 10 p.p.	24 (1)	24 (1)
15 to 25 p.p.	23.5 (1)	23.5 (1)
30 to 40 p.p.	21.5 (1)	21.5 (1)
E filtered Cyl. Stock	15.5 (1)	15.5 (1)

Note: To obtain prices delivered in Chicago add 0.25c per gal.

Natural Gasoline

(Group 3 & Breckenridge prices are to blenders on freight basis shown below. Shipments may originate in any Mid-Continent manufacturing district.)

FOB GROUP 3		
Grade 26-70	4.5 (Quotes)	4.5 (Sales)
FOB BRECKENRIDGE		
Grade 26-70	3.5 (Sale)	3.5 (Sale)

CALIFORNIA (FOB plants in Los Angeles basin)

21 pound vapor pressure for blending	4.75	4.75

Naphtha and Solvent

(*FOB Group* 3)

Stoddard solvent	6.625	6.625
Cleaners' naphtha	7.125	7.125
V.M.&P. naphtha	7.1 - 7.125	7.1 - 7.125
Mineral spirits	6.1 - 6.125	6.1 - 6.125
Rubber solvent	7.1 - 7.125	7.1 - 7.125
Lacquer diluent	7.375- 8.125	7.375- 8.125
Benzol Diluent	7.875- 8.625	7.875- 8.625

WESTERN PENNA.

Other Districts:

Untreated naphtha	7-7.725 (2&a)	7-7.725 (2)
Stoddard solvent	7.25 -7.5	7.25 -7.5

(a) Effective on and since Sept. 14.

OHIO (S. O. quotations for statewide delivery:) V.M.&P. naphtha, D.C. naphtha, Varnolene &

Sohio solvent	10	10
Rubber solvent	9	9

Wax

WESTERN PENNA. (Bbls. C.L.)
White Crude Scale:

122-124 A.m.p.	4.25 (2)	4.25 (2)
124-126 A.m.p.	4.25	4.25

MID-CONTINENT (C.L. FOB Refinery)

Semi-refined:		
128 AMP min., white, 50 kilo bags	No Price	No Price
132-134 AMP, bbls.	5.25 (1)	5.25 (1)

CHICAGO (FOB Chicago district refinery of one refiner, in bags, carloads. Carloads, slabs loose, 0.4c less. Melting points are EMP (ASTM) methods; add 3° to convert into AMP.)

Fully refined:		
122-124 (bags only)	5.6	5.6
125-127	6	6
127-129	6.25	6.25
130-132	6.55	6.55
133-134	6.8	6.8
135-137	7.55	7.55

Petrolatums

WESTERN PENNA. (Bbls., carloads: tank cars, 0.5c per lb. less.)

Snow White	6.125- 7.25	6.125- 7.25
Lily White	5.375- 6.25	5.375- 6.25
Cream White	4.375- 5.5	4.375- 5.5
Light Amber	3.375- 4	3.375- 4
Amber	3.125- 3.75	3.125- 3.75
Red	3 - 3.5	3 - 3.5

Tank Wagon Prices

Commercial or consumer tank car, tank wagon dealer, and service station prices for gasoline **do not include taxes**; *they do, however, include inspection fees as shown in general footnote. Gasoline taxes, shown in separate column, include 1.5c federal, and state taxes; also city and county taxes as indicated in footnotes. Kerosine tank wagon prices also do not include taxes; kerosine taxes where levied are indicated in footnotes. Dealer discounts are shown in footnotes. These prices in effect Oct. 1, 1945 as posted by principal marketing companies at their headquarters offices, but subject to later correction.*

S. O. N. J.

Esso (*Regular Grade*)

	Consumer Tank Wagon	Dealer T.W.	Gasoline Taxes	Kerosine T.W.
Atlantic City, N. J.	9.0	9.5	4.5	8.5
Newark	9.0	9.5	4.5	8.5
Annapolis, Md.	9.35	9.85	5.5	...
Baltimore	8.75	9.25	5.5	9.3
Cumberland	10.15	10.65	5.5	10.8
Washington, D. C.	9.0	9.5	4.5	9.8
Danville, Va.	10.45	10.95	6.5	10.05
Petersburg	9.55	10.05	6.5	10.8
Norfolk	9.25	9.75	6.5	9.8
Richmond	9.55	10.05	6.5	10.8
Roanoke	10.75	11.25	6.5	10.3
Charleston, W. Va.	11.05	11.55	6.5	12.1
Parkersburg	10.35	10.85	6.5	11.8
Wheeling	10.35	10.85	6.5	12.4
Charlotte, N. C.	10.9	11.4	7.5	9.1
Hickory	11.45	11.95	7.5	10.1
Mt. Airy	11.3	11.8	7.5	9.3
Raleigh	10.65	11.15	7.5	10.1
Salisbury	10.95	11.45	7.5	10.5
Charleston, S. C.	9.75	10.25	7.5	....
Columbia	10.6	11.1	7.5	....
Spartanburg	11.3	11.8	7.5	....
New Orleans, La.	8.75	9.25	8.5**	10.0
Baton Rouge	8.75	9.25	8.5**	10.5
Alexandria	8.75	9.25	8.5**	10.5
Lake Charles	9.0	9.5	8.5**	12.0
Shreveport	8.5	9.0	8.5 **	9.0
Knoxville, Tenn.	10.5	11.0	8.5	12.5
Memphis	8.9	9.4	8.5	10.5
Chattanooga	10.5	11.0	8.5	11.0
Nashville	10.5	11.0	8.5	10.0
Bristol	9.75	10.25	8.5	10.0
Little Rock, Ark.	9.5	10.0	8.0	10.0
New Iberia, La.	9	9.5	8.5 **	8

	Mineral Spirits T.W.	V.M.&P. T.W.
Newark, N. J.	13	14.5
Baltimore, Md.	15.5	....
Washington, D. C.	15.5	....

Fuel Oils—T.W.	No. 1	No. 2	No. 3
Atlantic City, N. J.	8.5	7.5	9
Newark	8.5	7.5	9
Baltimore, Md.	8.3	7.5	9
Washington, D. C.	8.8	7.9	9.4
Norfolk, Va	8.5	7.3	8.8
Petersburg	8.8	7.5	...
Richmond	8.8	7.5	9
Charlotte, N. C.	9.1	8.9	...
Hickory	...	8.5	...
Raleigh	10.1	8.6	...
Charleston, S. C.	...	7.5	...
Columbia	...	8.5	...
Spartanburg	...	9.3	...

Effective Sept. 1, 1945, in the States of New Jersey, Delaware, Maryland, District of Columbia and Virginia, prices for No. 1 and No. 2 Fuel Oil were reduced 1.5c per gallon, all methods of delivery, as authorized by the Office of Price Administration. On the same date prices for No. 1 and No. 2 Fuel were reduced 1.20c per gallon in North and South Carolina.

*Effective Aug. 5, '42 minimum retail resale price of 14.2c posted thru New Jersey.

Discounts:

**Includes 1.0c per gallon State Tax.

*Effective Nov. 7, 1944, the discount for kerosine in the State of Virginia was eliminated, the discount in Tennessee was eliminated May 1, 1945 and the discount in Louisiana was eliminated May 7, 1945.

Undivided Dealers at Dealer Tank Wagon price less 0.5c per gallon for Esso Gasoline.

Esso gasoline—to undivided dealers, 0.5c off dealer t.w.

Kerosine—1c off t.w. price for 25 gals. or more, under contract thru territory (Baltimore city contract not necessary) except no discount in state of New Jersey, Virginia, Tennessee and Louisiana.

Naphtha—To buyers taking following quantities at one time: Newark, 2c per gal. on 200 gals. or more, less than 200 gals. 0.5c higher price; Baltimore, 2c off on 25 to 100 gals. and 3c on over 100 gals.; Washington, 2c off to contract buyers.

Effective September 1, 1945, in the States of New Jersey, Delaware, Maryland, and the District of Columbia, the price of all motor fuel and kerosene was reduced 1.20c and 1.50c per gallon, respectively, as authorized by the Office of Price Administration. At the same time motor fuel prices were reduced 0.60c per gallon and kerosene prices were reduced 1.0c per gallon in West Virginia and motor fuel and kerosene prices were reduced 0.80c and 1.20c per gallon, respectively, in North and South Carolina.

Notice

These prices include inspection fees on both gasoline and kerosine unless otherwise specified per gallon as follows:

Ala. 1/40c on gasoline; Ark. 1/20c; Fl. 1/8c; Ill. 3/100c; Ind. 1/5c in lots of 25 bbls. or less, 2/25c in lots of more than 25 bbls.; Kans. 1/50c; La. 1/32c; Minn. 7/200c; Miss. 1/50c; Neb. 3/100c; Nev. 1/20c; N. C. 1/4c; N. Da. 1/20c; Okla. 2/25c; S. Car. 1/8c; S. Da. 1/20c; Tenn. 2/5c; and Wisc. 3/100c.

Kerosine inspection fees only: Ala. 1/2c; Fla. 1/8c; Iowa 3/50c; Mich. 1/5c per gal.

CONT'L OIL

	Conoco Bronz-z-x (*3rd Grade*) †Tank Wagon	Demand (*3rd Grade*) Dealer T.W.	Gasoline Taxes	Kerosine T.W.
Denver, Col.	10	9	5.5	10
Grand Junc., Col.	12.5	11.5	5.5	12.5
Pueblo, Col.	9.5	8.5	5.5	9.5
Casper, Wyo.	11.5	10.5	5.5	12
Cheyenne, Wyo.	10	9	5.5	9
Billings, Mont.	12	11	6.5	12.5
Butte, Mont.	11.5	10.5	6.5	13.5
Great Falls, Mont.	12	11	6.5	12.5
Helena, Mont.	12	11	6.5	13
Salt Lake City, Utah	13.5	12.5	5.5	14.5
Twin Falls, Ida.	14.5	13.5	7.5	17
Albuquerque, N. M.	10.5	9.5	*7	9.5
Roswell, N. M.	10	9	*7	7
Santa Fe, N. M.	10.5	9.5	*7.5	10
Ft. Smith, Ark.	9	6.25	8	8
Texarkana, Ark.	9	7.5	*5.5	7
Muskogee, Okla.	7.75	6.75	9	8
Oklahoma City, Okla.	8	7	9	8
Tulsa, Okla.	8	7	9	8

*Taxes: In gasoline tax column are included these city taxes—Albuquerque, & Roswell, 0.5c, Santa Fe, 1c. Texas 4c state tax applies within city limits of Texarkana, Ark.

†To consumers & Dealers.

NOTE: Current selling price—where this is lower than maximum price it is because of local competition. It is the actual selling price and is subject to revision due to delays in receiving information from the field.

Arkansas tax 8c applies at Ft. Smith.

S. O. CAL.

Standard Gasoline (*Regular Grade*)
Flight Gasoline (*Third Grade*)

	Standard Posted Net Tank Truck	Standard Posted Retail	Flight Posted Net Tank Truck	Flight Posted Retail	Gasoline Taxes
San Francisco, Cal.	10	14	9	12	4.5
Los Angeles, Cal.	9.5	13.5	8.5	11.5	4.5
Fresno, Cal.	11	15	10	13	4.5
Phoenix, Ariz.	12	16	10	13	6.5
Reno, Nev.	12	16	11	14	5.5
Portland, Ore.	10.5	14.5	9.5	12.5	6.5
Seattle, Wash.	10.5	14.5	9.5	12.5	6.5
Spokane, Wash.	12.5	16.5	11.5	14.5	6.5
Tacoma, Wash.	10.5	14.5	9.5	12.5	6.5
Boise, Ida.	13.5	17.5	12.5	15.5	7.5

*Chevron Aviation 73

	Posted Net Tank Truck	Gasoline Taxes	Kerosine Tank Truck
San Francisco, Cal.	12.5	4.5	11.5
Los Angeles, Cal.	12	4.5	10
Fresno, Cal.	13.5	4.5	12.5
Phoenix, Ariz.	14.5	6.5	12.5
Reno, Nev.	14.5	5.5	13.5
Portland, Ore.	13	6.5	13.5
Seattle, Wash.	13	6.5	13.5
Spokane, Wash.	16	6.5	16.5
Tacoma Wash.	13	6.5	13.5
Boise, Ida.	18	4.0	16.5

Resale and Commercial Gasoline: Tank car deliveries of Chevron Aviation 73, Standard's Supreme and Flight Gasoline .25c per gal. below posted net tank truck price. Tank car deliveries of Standard Gasoline .375c per gal. below posted net tank truck price. Pearl Oil (The Standard Kerosene) Tank car deliveries 3c below posted tank truck price.

*Formerly Standard Aviation 73.

TEXAS CO.

	Gasoline—Dealer T.W. Fire-Chief (Regular)	Indian (*3rd Grade*)	Gasoline Taxes
Dallas, Tex.	7.5	6.5	5.5
Ft. Worth, Tex.	7.5	6.5	5.5
Wichita Falls, Tex.	8.5	7.5	5.5
Amarillo, Tex.	8.5	7.5	5.5
Tyler, Tex.	8.5	7.5	5.5
El Paso, Tex.	11	10.5	5.5
San Angelo, Tex.	8.5	7.5	5.5
Waco, Tex.	8.5*	7*	5.5
Austin, Tex.	8.5	7.5	5.5
Houston, Tex.	8.5	7.5	5.5
San Antonio, Tex.	8.5	7.5	5.5
Port Arthur, Tex.	8.5	7.5	5.5

*Less 1c temporary allowance to all dealers

(Continued on next page)

Tank Wagon Prices—Continued

S. O. IND.

	Red Crown Blue Crown Red Dealer Prices Crown Cons. T.W.	Red Crown	Blue Crown	(Regular Grade) (Third Grade) Gaso-line Taxes	Kero-sine T.W.
Chicago, Ill.	11.6	9.6	9.1	4.5	10.3
Decatur, Ill.	11.6	9.6	8.7	4.5	10
Joliet, Ill.	11.9	10.3	9.2	4.5	10.3
Peoria, Ill.	11.7	9.9	9.7	4.5	10.1
Indianapolis, Ind.	11.6	10.1	9.6	5.5	9.8
Evansville, Ind.	11.4	9.9	8.6	5.5	9.6
South Bend, Ind.	12	10.5	10	5.5	10.2
Detroit, Mich.	11.4	9.9	...	4.5	9.7
Grand Rapids, Mich.	11.4	9.9	...	4.5	9.6
Saginaw, Mich.	11.4	9.9	...	4.5	9.6
Green Bay, Wis.	12.2	10.7	10.2	5.5	10.6
Milwaukee, Wis.	12.1	10.6	10.1	5.5	10.5
La Crosse, Wis.	11.9	10.4	9.9	5.5	10.3
Minneapolis - St. Paul.	11.9	10.4	9.9	5.5	10.3
Duluth, Minn.	12.2	10.7	....	5.5	10.6
Mankato, Minn.	11.9	10.4	9.9	5.5	10.3
Des Moines, Ia.	11.4	9.9	9.4	5.5	*9.8
Mason City, Ia.	11.7	10.2	9.7	5.5	*10.1
St. Louis, Mo.	11.0	9.5	9.3	*4.5	9.8
Kansas City, Mo.	11.0	9.5	8.6	*4.5	9.4
St. Joseph, Mo.	11.2	9.7	9.2	*4.5	9.6
Fargo, N. D.	12.9	11.4	10.9	5.5	11.3
Huron, S. D.	12.3	10.8	10.3	5.5	10.7
Wichita, Kans.	10.3	8.8	7.2	4.5	8.7
Omaha, Neb.	11.4	9.6	9.4	6.5	9.8

	Oleum Spirits	V.M.&P. Naphtha	Stani-sol	*Taxes
(Prices are base prices before discounts)				
Chicago	13.5	13.8	12.8	4.5
Detroit	15.8	15	16.3	4.5
K. C., Mo.	13.3	14.3	13.8	1.5
St. Louis, Mo.	13.7	14.7	13.2	1.5
Milwaukee	14.4	15.4	14.9	5.5
Minneap'lis	14.2	15.2	13.5	5.5

Fuel Oils T.W.

Chicago

	Standard Heater Oil	Stanolex Furnace Oil
1-99 gals.	9.0	8.5
100-149 gals.	8.0	7.5
150 gals. & over	7.5	...
150-399 gals.	...	7.5
400 gals. & over	...	7.0

	Stanolex Fuel A	Stanolex Fuel C
1-749 gals.	6.2	5.7
750 gals. & over	5.45	4.95

Stanolex Furnace Oil

Other Points	1-99 gals.	100 gals. X over
Indianapolis	8.7	7.7
Detroit	8.4	7.4
Milwaukee	8.7	7.7
Minneapolis	8.8	7.8
St. Louis	8.1	7 1
Kansas City	7.8	6.8

*Taxes: In gasoline tax column are included these city taxes—Kansas City, St. Joseph and St. Louis, 1c. Iowa kerosine prices are ex 4c state tax. In naphtha tax column are included 1.5c federal tax and state taxes.

State sales, occupation, consumer and use taxes to be added when applicable.

S. O. OHIO

	*Sohio X-70 Gasoline (Regular Grade) Con-sumer T.W.	**Re-sel-lers	‡S.S.	Gaso-line Taxes	†Kero-sine T.W.
Ohio, Statewide	12	10	13.5	5.5	9.0
Akron	12	9.5	12.5	5.5	9.0
Canton	12	9.5	12.5	5.5	9.0
Cincinnati	12	9.5	12.5	5.5	9.0
Cleveland	12	9.5	12.5	5.5	9.0
Columbus	12	9.5	12.5	5.5	9.0
Dayton	12	9.5	12.5	5.5	9.0
Lima	12	9.5	12.5	5.5	9.0
Mansfield	12	9.5	12.5	5.5	9.0
Marion	12	9.0	12.0	5.5	9.0
Portsmouth	12	9.5	12.5	5.5	9.0
Toledo	12	9.5	12.5	5.5	9.0
Youngstown	12	9.5	12.5	5.5	9.0
Zanesville	12	9.5	12.5	5.5	9.0

Aviation Gasoline—Statewide

	Consumer Gasoline T.W.	Taxes
Sohio Aviation Gasoline clear Spec. AN-F-22	14.5	5.5
Esso Ethyl Aviation 73 Oct.	15.5	5.5
Esso Ethyl Aviation 80 Oct.	16.5	5.5
Esso Ethyl Aviation 91 Oct.	17.5	5.5
Esso Ethyl Aviation 100 Oct.	24.5	5.5

	Naphtha—T.W. Statewide	Lucas County
S. R. Solvent	13.5	13.5
D. C. Naphtha	14.5	14.25
V.M.&P. Naphtha	14.5	14.25
Varnolene	14.5	14.25
Sohio Solvent	14.5	14.25

Fuel Oils—T.W.	No. 1	No. 2	No. 3	No. 4
Ohio, Statewide	8.0	8.0	7.5	*7.25

*Renown (third-grade) prices are same as X-70 unless otherwise noted.

**Except authorized agents.

‡Prices at company-operated stations.

††Statewide prices are subject to exceptions other than those shown.

Discounts:

Esso aviation—on contract to hangar operators and resellers, 2c off consumer t.w.

*For Cleveland area only. Full compartment hose dumps.

Fuel oils—Statewide prices are for t.w. & drum deliveries of 50 gals. or more; prices for deliveries of less than 50 gals are 0.5c higher.

Naphthas—to contract consumers off t.w. prices—Statewide: 300 to 999 gals., 0.5c; 1000 to 2499 gals., 0.75c; 2500 to 4999 gals., 1c; 5000 or more gals., 1.5c. Lucas County: Less than 50 gals., tank wagon price, 50 to 249 gals., 0.5c; 250 to 499 gals., 1c; 500 gals. or over, 1.5c.

ATLANTIC REFINING

Atlantic White Flash (Regular Grade)

	Commer-cial T.W.	Dealer T.W.	Gaso-line Taxes	Kero-sine T.W.
Philadelphia, Pa.	9	9.5	5.5	10.75
Pittsburgh	9.5	10	5.5	11.1
Allentown	9.5	10	5.5	11.1
Erie	9.5	10	5.5	11.1
Scranton	9.5	10	5.5	11.1
Altoona	9.5	10	5.5	11.1
Emporium	9.5	10	5.5	11.1
Indiana	9.5	10	5.5	11.1
Uniontown	9.5	10	5.5	11.1
Harrisburg	9.5	10	5.5	11.1
Williamsport	9.5	10	5.5	11.1
Dover, Del.	...	10	5.5	11.1
Wilmington, Del.	...	9.5	5.5	10.6
Boston, Mass.	...	9.7	4.5	....
Springfield, Mass.	...	10.6	4.5	....
Worcester, Mass.	...	10.3	4.5	....
Fall River, Mass.	...	9.8	4.5	....
Hartford, Conn.	...	10.4	4.5	....
New Haven, Conn	...	9.8	4.5	....
Providence, R. I.	...	9.8	4.5	....
Atlantic City, N. J.	...	9.5	4.5	8.5
Camden, N. J.	...	9.5	4.5	8.5
Trenton, N. J.	...	9.5	4.5	8.5
Annapolis, Md.	...	9.85	5.5	9.3
Baltimore, Md.	...	9.25	5.5	8.3
Hagerstown, Md.	...	10.35	5.5	8.8
Richmond, Va.	...	10.05	6.5	10.8
Wilmington, N. C.	...	10.35	7.5	10.4
Brunswick, Ga.	...	9.5	7.5	*9.6
Jacksonville, Fla.	...	9.5	8.5	10.6

	Mineral Spirits T.W.†	V.M.&P. T.W.†
Philadelphia, Pa.	11	12.5
Lancaster, Pa.	12	13.5
Pittsburgh, Pa.	12.5	13.5

FUEL OILS—T.W.

	1	2	3	5	6
Phila., Pa.	8.6	7.5	7.5	5.24	4.53
Allentown, Pa.	9.1	7.8	7.8	....	....
Wilmington, Del.	8.6	7.5	7.5	....	....
Springfield, Mass.	....	7.9	7.9	....	....
Worcester, Mass.	....	7.9	7.9	....	....
Hartford, Conn.	....	7.7	7.7	....	....

*Does not include 1c Georgia kerosine tax.

†Mineral Spirits prices also apply to Stoddard Solvent; V.M.&P. prices also apply to Light Cleaners Naphtha.

Discounts:

Gasoline—to undivided dealers, 0.5c off dealer t.w. except Georgia & Florida dealer t.w. and undivided dealer t.w. prices are same.

Kerosine—Thru Penna. & Delaware, 2c off t.w. price on t.w. deliveries of 25 gals. or more at one time.

S. O. KY.

Crown Gasoline (Regular)

	†Crown-Gaso-line	Gaso-line Taxes	Kero-sine T.W.
Covington, Ky.	9.5	6.5	9.3
Lexington, Ky.	10.5	6.5	9.3
Louisville, Ky.	10	6.5	8.8
Paducah, Ky.	10	6.5	8.8
Jackson, Miss.	10	7.5	*9.0
Vicksburg, Miss.	9.5	7.5	*8.5
Birmingham, Ala.	10	*8.5	9.0
Mobile, Ala.	9	*9.5	8.5
Montgomery, Ala.	10	*9.5	*10.0
Atlanta, Ga.	10.5	7.5	*10.6
Augusta, Ga.	10.5	7.5	*10.1
Macon, Ga.	10.5	7.5	*10.6
Savannah, Ga.	9.5	7.5	*9.6
Jacksonville, Fla.	9.5	8.5	8.6
Miami, Fla.	9.5	8.5	8.6
Pensacola, Fla.	9	*9.5	8.0
Tampa, Fla.	9.5	8.5	8.6

NOTICE

These prices include inspection fee on both gasoline and kerosine unless otherwise specified per gallon as follows: Ala. 1/40c on gasoline; Florida 1/8c.

Kerosine inspection fee only: Ala. 1/2c.

HUMBLE OIL

Humble Motor Fuel (Regular Grade)

	Thriftane Humble *Tank Wagon	Re-tail	(Third Grade) Thriftane *Tank Wagon	Re-tail	Gaso-line Taxes
Dallas, Tex.	*7.5	10.5	*6.5	8.5	5.5
Ft. Worth, Tex.	*7.5	10.5	*6.5	8.5	5.5
Houston, Tex.	8.5	12.5	7.5	10.5	5.5
San Ant., Tex.	8.5	12.5	7.5	10.5	5.5

*Consumer tankwagon prices 1c per gallon above dealer tankwagon prices on Humble Gasoline, and Thriftane.

	Kerosine *Tank Wagon	Retail
Dallas, Tex.	7	10
Ft. Worth, Tex.	7	11
Houston, Tex.	8	11
San Antonio, Tex.	7	10

*To all classes of dealers & consumers.

Canada

PRICES OF IMPERIAL OIL, LTD.

Per Imperial Gallon, which is 1.2 U. S. Gallons

IMPERIAL OIL

3-Star Imperial Gasoline (Regular Grade)

	†Gasoline T.W.	*Gasoline Taxes	Kero-sine T.W.
Hamilton, Ont.	16.5	11	18
Toronto, Ont.	16.5	11	18
Brandon, Man.	20.5	10	22.5
Winnipeg, Man.	20.0	10	22
Regina, Sask.	17.5	11	19.5
Saskatoon, Sask.	20.3	11	22.3
Edmonton, Alta.	18.4	10	20.4
Calgary, Alta.	15.5	10	17.5
Vancouver, B. C.	15	10	24
Montreal, Que.	16.5	11	17.5
St. John, N. B.	16	13	19
Halifax, N. S.	16	13	19

*Includes 3c Federal, and Provincia taxes.

†To divided & undivided dealers.

SOCONY VACUUM

	Socony Mobilgas (Regular Grade) Com. Cons. T.W.	Undiv. Dlr. T.W.	Gaso-line Taxes
New York City			
Manhattan & Bronx	8.9	9.4	*5.5
Kings & Queens	8.9	9.4	*5.5
Richmond	8.5	9.0	*5.5
Albany, N. Y.	8.7	9.2	5.5
Binghamton, N. Y.	9.8	10.3	5.5
Buffalo	9.0	9.5	5.5
Jamestown, N. Y.	9.2	9.7	5.5
Mt. Vernon, N. Y.	8.9	9.4	5.5
Plattsburg, N. Y.	9.8	10.3	5.5
Rochester, N. Y.	9.6	10.1	5.5
Syracuse, N. Y.	9.3	9.8	5.5
Bridgeport, Conn.	8.8	9.3	4.5
Danbury, Conn.	9.3	9.8	4.5
Hartford, Conn.	9.4	9.9	4.5
New Haven, Conn.	8.8	9.3	4.5
Bangor, Me.	9.5	10.0	5.5
Portland, Me.	9.1	9.6	5.5
Boston, Mass.	8.7	9.2	4.5
Concord, N. H.	10.2	10.7	5.5
Lancaster, N. H.	10.8	11.3	5.5
Manchester, N. H.	10.1	10.6	5.5
Providence, R. I.	8.8	9.3	4.5
Burlington, Vt.	9.7	10.2	5.5
Rutland, Vt.	9.8	10.3	5.5

(Continued on next page)

Seaboard Export Coastwise Prices

Atlantic Coast

(Prices are of refiners, FOB their refineries & their tanker terminals, & of tanker terminal operators FOB their terminals)—Prices in Effect October 1.

MOTOR GASOLINE

District	70-72 Oct. (ASTM)	73-75 Oct. (ASTM)	KEROSINE and/or NO. 1 FUEL
N. Y. Harb.	....	8	5.6
N. Y. Harb., barges	....	7.9	5.5
Albany	7.975	8.1	5.8
Philadelphia	....	8	5.7
Baltimore	....	7.75	5.7
Norfolk	7.375	7.5	5.6
Wilmington, N. C.	7.375	7.5	5.55
Charleston	7.375	7.5-7.625 (b)	5.7
Savannah	7.245- 7.25	7.37 - 7.375	5.55
Jacksonville	7.245- 7.25	7.37 - 7.375	5.55
Miami	7.245- 7.25	7.37 - 7.375	5.55
Tampa	7.245- 7.25	7.37 - 7.375	5.55
Pensacola	....	7	4.8 (1)
Mobile	....	6.87	4.75 (2)
New Orleans	....	6.25	4.125- 4.25
Portland	8.175	8.3	5.8
Boston	8.075	8.2	5.7 - 5.8
Providence	....	8.2	5.7 - 5.8

FUEL OILS

District	No. 2	No. 3	No. 5	No. 6
N. Y. Harb.	5.2	5.2	$1.63 -$1.73	$1.55
N. Y. Harb., barges	5.1	5.1	....	....
Albany	5.3	5.3	....	$1.75 (1)
Philadelphia	5.2 (1)	5.2	$1.76 (2)	$1.55
Baltimore	5.2	5.2 (2)	$1.63 (1)	$1.55
Norfolk	5.2	....	$1.595 (1)	$1.515
Wilmington, N. C.	5.2	....	....	....
Charleston	5.2 (2)	....	$1.53 (1)	$1.45 (2)
Savannah	4.75 (2)	....	....	$1.445 (1)
Jacksonville	4.75	....	....	$1.43
Miami	4.75 (2)	....	....	....
Tampa	4.75	....	....	$1.32
Pensacola	....	....	....	....
Mobile	....	....	....	....
New Orleans	3.75 (2)	....	$1.05	$0.97
Portland	5.3	5.3 (1)	....	$1.60
Boston	5.3	5.3 (1)	$1.775 (2)	$1.595
Providence	5.3	5.3 (1)	$1.70 (1)	$1.57

Tank Wagon Prices (Continued)

	Mineral Spirits T.W.	V.M.&P T.W.
Buffalo, N. Y.	10.9	12.1
New York City	11	12
Rochester, N. Y.	11.8	13.1
Syracuse, N. Y.	12.2	....
Boston, Mass.	12	13
Bridgeport, Conn.	†16.3	†17.3
Hartford, Conn.	†16.3	†17.3
Providence, R. I.	13	14

	Kerosine Yard	Kerosine T.W.	Mobilfuel Diesel T.C.	Mobilfuel Diesel T.W.	Mobilheat Fuel Yard	Mobilheat Fuel T.W.
New York:						
Manhat'n & Bronx	6.0	8.8	....	7.8	5.6	7.5
Kings & Queens	6.0	8.8	....	7.8	5.6	7.5
Richmond	6.0	8.8	....	....	5.6	7.5
Albany	6.0	8.3	5.3	7.8	5.5	7.5
Binghamton	7.4	9.7	....	9.2	6.9	8.7
Buffalo	7.1	9.4	6.5	8.8	6.7	8.5
Jamestown	7.2	9.5	....	9.1	6.8	8.5
Mt. Vernon	6.1	8.8	....	7.9	5.7	7.5
Plattsburg	6.6	8.9	....	8.4	6.1	7.9
Rochester	7.2	9.5	6.4	8.7	6.4	8.2
Syracuse	7.0	9.3	6.3	8.6	6.3	8.1
Conn.:						
Bridgeport	6.3	8.8	....	8.0	5.8	7.5
Danbury	6.7	9.3	....	....	6.3	7.0
Hartford	6.5	9.0	....	8.0	5.9	7.7
New Haven	6.0	8.8	5.5	7.8	5.6	7.5
Maine:						
Bangor	6.4	8.8	5.9	8.2	5.9	7.6
Portland	6.0	8.7	5.3	7.8	5.5	7.5
Mass.:						
Boston	6.3	9.1	5.3	7.8	5.7	7.6
N. H.:						
Concord	6.9	9.2	....	9.0	6.7	8.5
Lancaster	8.0	10.3	....	10.0	7.7	9.5
Manchester	6.5	8.8	....	8.7	6.0	7.9
R. I.:						
Providence	6.3	8.8	5.3	7.8	6.7	7.6
Vermont:						
Burlington	6.6	8.9	6.0	8.3	6.0	7.7
Rutland	6.8	9.1	....	8.5	6.2	8.0

Effective Sept. 1, 1945.

*Does not include 1% city sales tax applicable to price of gasoline (ex tax).

†In steel barrels

Discounts: Diesel—On t.w. deliveries, 0.5c for at least 400 gals.; 1c for full tank truck.

EXPORT PRICES

Effective September 24

	Mexican Gulf Ports U. S. Dollars per Bbl. Bunker C	Diesel
Tampico	$0.97	$1.65
Veracruz	0.97	....
Coatzacoalcos	0.97	1.65
	Pacific Coast	
Guaymas	$1.50	$3.22
Mazatlan	1.50	3.22
Acapulco	1.50	2.89
Manzanillo	1.50	2.89
Salina Cruz	1.50	2.89

Pacific Export

In Ship's Bunkers, or deep tank lots:

Prices in Effect	Oct. 1	Sept. 24
Diesel Fuel, Pac. Spec. 200	$1.45	$1.45
Grade C fuel, Pac. Spec. 400	$1.10	$1.10

	Bunker C Fuel Ships' bunkers (Ex Lighterage)	Diesel Oil Ships' bunkers (Ex Lighterage)	Diesel Oil Shore Plants	Gas House Gas Oil 28-34 Gravity
New Haven	$1.57	....	....	....
N. Y. Harbor	$1.55	$2.15	5.2	5.3 (2)
Albany	$1.75 (1)	$2.31 (1)	5.3 (1)	5.5 (1)
Philadelphia	$1.55	$2.15	....	....
Baltimore	$1.55	$2.15 (2)	5.2 (1)	....
Norfolk	$1.515	$2.15 (2)	5.2 (1)	....
Charleston	$1.45 (2)	$2.15 (2)	5.2 (1)	....
Savannah	$1.445 (1)	....	....	....
Jacksonville	$1.43	$1.99 (1)	....	....
Tampa	$1.32	....	....	....
New Orleans	$0.97	$1.65 (1)	4 (1)	....
Portland	$1.60	....	5.3 (1)	5.4 (1)
Boston	$1.595	$2.19 (1)	5.3 (2)	5.4 (1)
Providence	$1.57	$2.192 (2)	5.3 (1)	5.3-5.4 (2)

(b) Effective Sept. 24, 1945.

Gulf Coast

Prices in Effect October 1

MOTOR GASOLINE	New Orleans & Lower Mississippi to Baton Rouge Tank Cars	New Orleans & Lower Mississippi to Baton Rouge Barges	Texas Gulf Coast South of New Orleans Tank Cars	Texas Gulf Coast South of New Orleans Barges	CARGOES Domestic & Export From all Gulf Ports
Leaded (oct. by ASTM)					
78-80 oct.	6.75	6.5	6.75	6.75	6.75
73-75 oct.	6 - 6.25	5.75	5.75-6.5 (b)	5.75	5.75
*70 oct.	....	....	....	....	5.625
80 oct. gasoline Research 2cc lead max.	....	....	....	....	6
Unleaded 70 oct.	....	....	....	....	5.625
67-68 oct.	....	....	....	....	....
65 oct.	....	....	....	....	5.25
60 oct.	....	....	....	....	5
KEROSINE & LIGHT FUELS					
41-43 w.w. kero.	4.125- 4.25	4.125	4.125- 4.25	4.125	4.125
42-44 w.w. kero.	....	....	4.125	4.125	4.125
No. 2 fuel oil	3.625- 3.75	3.75	3.75 - 4	3.75	3.75
DIESEL & GAS OILS					
(In diesel index No.)					
No. 5 fuel oil	$1.05	....	$1.05	....	....
43-47 di.	....	....	....	....	4
48-52 di.	4	4	4	....	4
53-57 di.	4.125	....	4.125	4.125	4.125
58 and above	4.25	....	4.25	....	4.25

(a) 5.75c for Dist. 1 and 6.25-6.50 for other districts.

NOTE: Above products in Truck Transports of 2,400 gal. and over ½c above Tank Car Prices.

(*) Retroactive to Sept. 19.

Heavy Fuels & Bunker Oil (at all Gulf Ports) Heavy Diesels	In Cargoes	In Ship's Bunkers (Ex Lighterage)
Below 28 API Grav.	....	$1.35
28 & above API Grav.	....	$1.65
Bunker C Oil	$0.97	$0.97

Mid-Continent Lubes

(At Gulf; in packages, FAS.; in bulk, FOB terminals).

Prices in Effect October 1

	Steel Drums	Bulk
Bright Stock		
D color, Vis at 210°		
200 vis.	....	....
150 vis., 0-10 p.p.	32.65 (1&a)	24.8 (1)
100 vis., 0-10 p.p.	....	....
100 vis., 10-25 p.p.	....	....
Neutral—No. 3 color		
200 vis., 0-10 p.p.	....	....

(A) FAS at New Orleans.

Wax

(Melting points are AMP, 3° higher than EMP) Prices are FOB refinery and do not include bag; freight or export differentials).

Prices in Effect October 1

Crude Scale	New Orleans Export	N. Y. Domestic	N. Y. Export
124-6 Yellow	4.25 (1)	....	4.25 (1)
122-4 White	....	4.25 (2)	4.25 (2)
124-6 White	4.25 (1)	4.25	4.25
Fully Refined:			
123-5	5.2 (1)	5.2 (2)	5.2 (1)
125-7	5.2 (1)	5.2 (2)	5.2 (1)
128-30	5.6 (1)	5.6	5.6 (2)
130-32	5.85 (1)	5.85 (2)	5.85 (1)
133-5	6.15 (1)	6.15	6.15 (2)
135-7	6.4 (1)	6.4 (1)	6.4 (1)

Naphtha

Prices in Effect October 1

	V.M.&P. Naphtha	Mineral Spirits
New York Harbor	11 (2)	10
Philadelphia	11 (2)	10
Baltimore	10.5 (2)	9.5
Boston	11.5 (2)	10.5
Providence	11.5 (1)	10.5 (2)

REFINERY OPERATIONS

(American Petroleum Institute figures in thousands of barrels of 42 gal. each. Figures include reported totals plus estimate of unreported amounts and are therefore on a Bureau of Mines basis.)

Districts	Daily Average Crude Runs to Stills Week Ended		Gasoline Production at Refineries inc. Natural Blended Week Ended		Kerosine Production Week Ended		Gas Oil & Dist. Fuel Oil Production Week Ended		Residual Fuel Oil Production Week Ended		Total Stocks Kerosine Week Ended	
	Sept. 22	Sept. 15	Sept. 22	Sept. 15	Sept. 22	Sept. 15	Sept. 22	Sept. 15	Sept. 22	Sept. 15	Sept. 22	Sept. 15
East Coast	709	702	1,934	1,848	200	216	980	1,034	1,383	1,395	6,147	6,014
Appalachian (Dist. 1)	93	94	321	322	44	50	58	61	56	66	412	406
Appalachian (Dist. 2)	53	54	165	181	12	8	35	41	110	113	71	65
Ind., Ill., Ky.	702	758	2,607	2,724	217	212	657	726	961	858	2,740	2,751
Okla., Kans., Mo.	398	382	1,459	1,381	149	166	368	323	502	429	1,093	1,066
Inland Texas	236	221	1,017	967	75	87	118	117	428	417	319	322
Texas Gulf Coast	1,019	1,101	3,194	3,523	343	475	1,345	1,446	1,254	1,494	1,649	1,651
Louisiana Gulf Coast	305	260	810	1,010	422	155	493	488	317	322	999	1,112
No. La. & Arkansas	84	86	224	230	77	84	62	67	118	131	256	259
Rocky Mt. (Dist 3)	12	12	32	32	6	6	11	11	29	30	15	15
Rocky Mt. (Dist. 4)	109	115	327	357	16	9	89	83	192	201	124	109
California	779	831	2,455	2,296	9	31	373	458	2,578	2,732	412	400
Total U. S.—B. of M. Basis	4,499	4,616	14,545	14,871	1,570	1,499	4,589	4,855	7,928	8,188	14,237	14,170
U. S.—B. of M. Basis, Sept. 23, 1944	4,657	4,634	14,139	14,474	1,609	1,419	4,574	4,350	9,109	8,235	14,236	13,824

Districts	Total Stocks Gas oil and Distillates Week Ended		Total Stocks Residual Fuel Oil Week Ended		Gasoline Stocks—*Military and Other** Week Ended		Gasoline Stocks—Civilian Grade Week Ended	
	Sept. 22	Sept. 15	Sept.22	Sept. 15	Sept.22	Sept. 15	Sept. 22	Sept. 15
East Coast	14,475	14,205	8,571	9,093	5,347	5,630	9,552	9,476
Appalachian (Dist. 1)	924	933	274	280	1,297	1,313	1,374	1,358
Appalachian (Dist. 2)	148	156	242	243	191	213	968	1,074
Ind., Ill., Ky.	6,093	5,953	3,245	3,323	4,483	5,086	12,641	12,581
Okla., Kans., Mo.	2,809	2,746	1,299	1,287	1,539	1,532	5,785	5,660
Inland Texas	445	448	1,051	1,047	906	1,032	1,796	1,641
Texas Gulf Coast	5,414	5,416	5,292	5,581	8,683	8,978	6,653	7,265
Louisiana Gulf Coast	1,867	2,030	1,084	1,139	1,590	2,110	2,554	2,183
N. La. & Arkansas	473	605	258	218	130	146	2,744	2,601
Rocky Mt. (Dist. 3)	20	21	33	35	15	15	74	75
Rocky Mt. (Dist. 4)	422	461	701	714	425	466	1,146	1,241
California	10,530	10,533	25,551	25,510	8,139	8,583	4,869	4,950
Total U. S.—B. of M. basis	43,620	43,507	47,601	48,470	32,745	35,104	50,156	50,105
U. S.—B. of M. Basis Sept. 23, 1944	43,175	42,082	62,533	62,243	36,837	37,156	40,286	40,213

*Includes aviation and military grades, finished and unfinished, title to which remains in the name of the producing company; solvents, naphthas, blending stocks currently indeterminate as to utimate use, 9,637,000 bbl. unfinished gasoline this week, compared with 11,965,000 bbl. a year ago.

**These figures do not include any gasoline on which title has already passed, or which the military forces may have in their own or leased storage.

Percent Daily Refining Capacity Reporting—East Coast, 99.5; Appalachian (Dist. 1) 76.8, (Dist. 2) 81.2; Ind., Ill., Ky., 87.2; Okla., Kans., Mo., 78.3; Inland Texas, 59.8; Texas Gulf Coast, 89.3; Louisiana Gulf Coast, 96.8; No. Louisiana & Arkansas, 55.9; Rocky Mt. (Dist. 3) 17.1; (Dist. 4) 72.1; California, 87.3; Total—U. S.—B. of M. Basis Sept. 22, 1945 85.8; Total—B. of M. Basis Sept. 15, 1945 85.8.

U. S. Crude Oil Production

(American Petroleum Institute figures)

	WEEK ENDED Barrels (Daily Average) Sept. 22	Barrels (Daily Average) Sept. 15
Oklahoma	*394,600	*392,050
Kansas	*273,450	*273,600
Nebraska	*850	*850
Texas	1,883,000	1,883,000
Louisiana	363,800	363,200
Arkansas	78,000	78,800
Mississippi	51,050	53,700
Alabama	250	1,000
Florida	200	200
Illinois	202,350	203,400
Indiana	13,200	13,000
Eastern (Ind., Ill. & Ky. excluded)	63,400	63,950
Kentucky	29,550	28,000
Michigan	45,100	51,100
Wyoming	108,050	113,800
Montana	20,100	20,100
Colorado	12,200	10,650
New Mexico	104,300	104,300
California	884,100	883,200
Total, U. S.	4,527,550	4,537,900

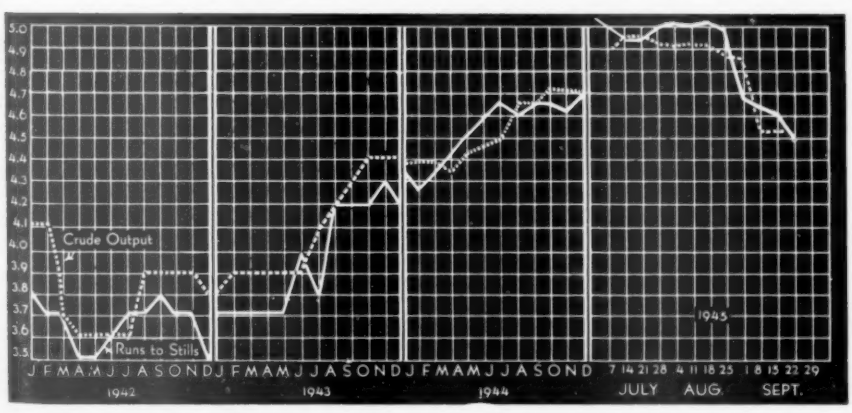
*Okla., Kans., Neb. figures are for week ended 7:00 a.m. Sept. 19, 1945.

Crude Oil Stocks

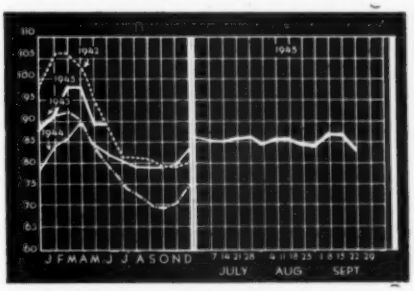
(Bureau of Mines Figures in thousands of bbls.)

Grade or Origin	Sept. 15	Sept. 22	Change from Sept. 15
Penna. Grade	2,061	2,053	−8
Other Appalachian	1,252	1,210	−42
Lima-Michigan	977	978	+1
Illinois-Indiana	12,651	12,776	+125
Arkansas	2,732	2,641	−91
Kansas	8,906	8,926	+20
Louisiana	12,440	12,439	−1
Northern	3,237	3,118	−119
Gulf Coast	9,203	9,321	+118
Mississippi	1,411	1,425	+14
New Mexico	5,964	6,199	+235
Oklahoma	31,909	33,252	+1,343
Texas:	106,346	105,851	−495
East Texas	18,058	18,170	+112
West Texas	32,110	32,167	+57
Gulf Texas	29,004	28,162	−842
Other Texas	27,174	27,352	+178
Panhandle	4,198	4,097	−101
North	6,863	6,765	−98
South	7,921	8,032	+111
Other	8,192	8,458	+266
Rocky Mountain	6,705	6,796	+91
California	17,261	17,585	+324
Foreign	3,865	3,286	−579
in U. S.	214,480	215,417	+937
Heavy in California	4,397	4,344	−53
Total gasoline-bearing			

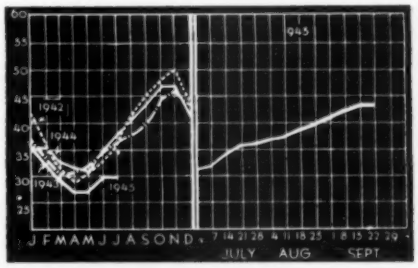
Crude Production & Runs to Stills *(Millions of Barrels)*



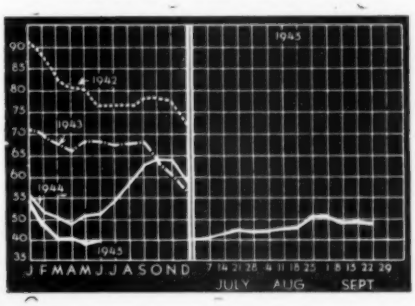
Gasoline Stocks *(Millions of Barrels)*



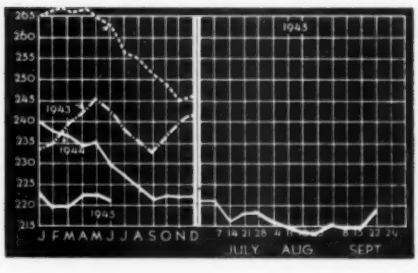
Gas Oil & Distillate Stocks *(Millions of Bbls.)*



Residual Fuel Oil Stocks *(Millions of Bbls.)*



Crude Oil Stocks *(Millions of Barrels)*



Pacific Coast Demand

(Bureau of Mines figures in thousands of bbls. daily)

	Gasoline		Gas Oil & Diesel		Heavy Fuel Oil		All Products	
	1944	1945	1944	1945	1944	1945	1944	1945
January	275	304	103	104	505	545	993	1,066
February	315	315	109	100	478	594	1,011	1,124
March	311	332	108	94	479	519	1,018	1,068
April	302	406	58	83	450	536	954	1,148
May	295	402	85	75	411	520	900	1,135
June	352	398	87	64	395	490	969	1,085
July	335	396	63	59	353	421	884	1,011
Aug.	329	...	63	...	349	...	883	..
Sept.	323	...	65	...	382	...	902	....
Oct.	313	...	70	...	450	...	945	....
Nov.	328	...	80	...	467	...	992	....
Dec.	319	...	101	...	558	...	1,093	
Jan.-July	312	365	92	82	438	517	961	1,090

Mid-Continent Lube Statistics (July 1945)

(Compiled by Western Petroleum Refiners Assn. from reports of member companies. Figures in bbls. of 42 gal.)

	Bright Stock	Viscous Neutrals	Paraffin Oils	Steam Refined Stock	Blended Oils
Production	226,299	305,365	69,338	18,011	364,150
Shipments:					
Domestic	216,659	340,300	71,751	18,985	364,160
Export	8,965	597	4	481	5,701
TOTAL	225,624	340,897	71,755	19,466	369,861
Inventory July 31	162,804	191,679	63,286	43,793	115,381

Pennsylvania Lubricating Oils

(Compiled by National Petroleum Assn. from reports of companies refining Pennsylvania Grade crude oil. Figures in bbls.)

	Production July 1945	Inventory July 1945	Production June 1945	Inventory June 1945
Raw Long Residuum	48,131	52,920	48,826	28,973
600 Steam Refined Stock	257,073	115,599	244,508	119,879
Other Steam Refined Stock	28,640	31,073	43,136	34,621
Finished dewaxed Long Residuum	60,404	36,660	46,427	25,255
Bright Stock	154,276	138,792	154,216	137,669
Viscous Neutral (below 180 Vis.)	46,314	119,186	45,028	110,482
Viscous Neutral (180 Vis. at 100)	107,941	126,817	99,915	107,154

Production of Natural 'Gas', Allied Products

	June 1945	May 1945
East Coast	.....	.....
W. New York	1	...
W. Pennsylvania	986	1,179
West Virginia	6,142	7,368
Ohio	420	527
Illinois	14,965	15,335
Kentucky	4,025	4,500
Michigan	1,174	1,134
Kansas	6,061	6,002
Oklahoma	33,963	35,928
Texas:	177,534	187,467
Gulf	43,765	44,811
East Texas	32,859	33,737
Panhandle	41,629	46,361
Other	59,281	62,558
Arkansas	7,331	7,378
Louisiana:	48,121	48,538
Gulf	26,922	27,178
Inland	21,199	21,360
New Mexico	9,155	8,914
Colorado	*	*
Montana	317	405
Wyoming	*4,559	*5,186
California	75,032	77,834
Total	389,786	407,695
Daily average	12,993	13,151
Total (thousands of bbls.)	9,281	9,707

*Wyoming includes Colorado drip gasoline.

Dealer and Service Station Gasoline Prices in 50 Representative U. S. Cities July, 1945

City	Dealers' Net Price (Ex. Tax)	Indicated Dealer Margin	Gasoline Tax (Inc. 1½ Cent Federal Tax)	Service Station (Inc. Tax)
Portland, Me.	10.80	4.0	5.50	20.30
Manchester, N. H.	11.80	4.1	5.50	21.40
Burlington, Vt.	11.40	4.0	5.50	20.90
Boston, Mass.	10.40	4.0	4.50	18.90
Providence, R. I.	10.50	4.2	4.50	19.20
Hartford, Conn.	11.10	4.0	4.50	19.60
Buffalo, N. Y.	10.10	4.2	5.50	19.80
New York, N. Y.	10.60	5.4	5.50	21.50
Newark, N. J.	10.20	5.0	4.50	19.70
Philadelphia, Pa.	10.20	4.2	5.50	19.90
Dover, Del.	10.70	4.3	5.50	20.50
Baltimore, Md.	9.95	4.05	5.50	19.50
Washington, D. C.	10.20	4.0	4.50	18.70
Charleston, W. Va.	11.65	4.05	6.50	22.20
Norfolk, Va.	10.45	5.55	6.50	22.50
Charlotte, N. C.	11.70	4.0	7.50	23.20
Charleston, S. C.	10.55	4.75	7.50	22.80
Atlanta, Ga.	11.10	4.0	7.50	22.60
Jacksonville, Fla.	10.10	4.0	8.50	22.60
Birmingham, Ala.	10.00	5.0	8.50	*23.50
Vicksburg, Miss.	9.50	5.0	7.50	22.00
Memphis, Tenn.	8.90	4.5	8.50	21.90
Lexington, Ky.	10.50	3.5	6.50	20.50
Youngstown, Ohio	9.50	3.0	5.50	18.00
South Bend, Ind.	10.50	4.5	5.50	20.50
Chicago, Ill.	9.60	2.76	4.50	16.86
Detroit, Mich.	9.90	3.74	4.50	18.14
Milwaukee, Wis.	10.60	4.3	5.50	20.40
Twin Cities, Minn.	10.40	4.5	5.50	20.40
Fargo, N. D.	11.40	4.0	5.50	20.90
Huron, S. D.	10.80	3.7	5.50	20.00
Omaha, Neb.	9.60	3.0	6.50	19.10
Des Moines, Ia.	9.90	3.5	5.50	18.90
St. Louis, Mo.	9.50	3.0	4.50	*17.00
Wichita, Kans.	8.80	3.2	4.50	16.50
Tulsa, Okla	8.00	3.0	9.00	20.00
Little Rock, Ark.	9.50	4.5	9.00	20.00
New Orleans, La.	8.75	4.75	8.50	22.00
Houston, Texas	8.50	4.5	5.50	18.50
Albuquerque, N. M.	10.50	4.5	7.00	‡22.00
Denver, Colo.	10.00	4.0	5.50	19.50
Casper, Wyo.	11.50	5.0	5.50	22.00
Butte, Mont.	9.50	4.0	6.50	20.00
Boise, Ida.	13.50	4.0	7.50	25.00
Salt Lake City, Utah	13.50	4.5	5.50	23.50
Reno, Nev.	12.00	4.0	5.50	21.50
Phoenix, Ariz.	12.00	4.0	6.50	22.50
San Francisco, Calif.	10.00	4.0	4.50	18.50
Portland, Ore.	10.50	4.0	6.50	21.00
Spokane, Wash.	12.50	4.0	6.50	23.00

*Includes City Tax of 1.00; ‡Includes City Tax of 0.50.

Pennsylvania Oils Other Than Lubes At Refineries

(Compiled by National Petroleum Assn. from reports of oil region refiners. Figures in barrels.)

	July, 1945	June, 1945
Naphthas & Gasoline		
(a) Straight run unblended and/or unleaded for sale as motor fuel	2,347	3,579
(b) Naphtha and gasoline for sale for blending or further refining, or held at refinery for further distillation, reforming blending or leading	236,916	246,303
(c) below 65 octane not included in (a) or (b) above	10,056	9,968
(d) 65 octane and above	192,333	197,556
Salable naphthas other than motor fuel material (Does not include refinery process naphthas)	11,503	12,531
Kerosine	75,894	73,211
36/40 gas oil (includes furnace oil)	49,713	44,862
Fuel oil (not reported above)	41,636	43,833
Oils held as cracking plant charging stocks	361,520	389,312
Non-viscous neutral	27,414	29,677
Wax distillate	86,169	89,658
Crude petrolatum	28,216	29,095
Wax (lbs.)	3,336,225	3,228,064

Net Stocks Of Pennsylvania Crude Oil

(Compiled by National Petroleum Assn. Figures in bbls.)

	July 31, 1945	June 30, 1945	July 31, 1944
At Refineries	310,232	288,323	244,824
Pipeline and Tank Farm	1,425,236	1,462,437	1,419,365

CRUDE PRICES

Since changes in crude oil prices are few, the two pages of crude oil price tables are printed only when there are sufficient changes to warrant.

A record is kept in the Cleveland office of NPN and OILGRAM from which the publishers will be glad to make proofs, or letters or affidavits as to what the prices are, and without charge to regular subscribers.

Crude Price Changes

No price changes reported for week ending Sept. 26.

For latest table of crude prices published see NPN Sept. 26, pages 75, 76 and 77.

Daily Av. Pennsylvania Crude Runs

(Compiled by National Petroleum Assn. from reports of all companies refining Pennsylvania crude. Figures in bbls.)

Week Ended	Week Ended	Week Ended
Sept. 22, 1945	Sept. 15, 1945	Sept. 23, 1944
59,004	61,763	66,229

Nov. 15 Deadline For Phillips In Its Suit Against Shell

Special to NPN

HOUSTON, Tex.—Federal Judge T. M. Kennerly has given the Phillips Petroleum Co. until Nov. 15 to get in its briefs in connection with its suit against the Shell Oil Co. for alleged patent infringements in the use of sulfuric acid alkylation at Shell's Deer Park refinery near Houston. Shell's attorneys were given until Jan. 15 to reply.

Judge Kennerly's order followed nine days of testimony by an array of scientists and technicians introducing evidence from both sides. As the case opened attorneys for both firms asked Judge Kennerly to invoke the National Espionage Act in order to avoid possible publicity of some of the secret processes involved. At first newsmen were barred but later they were invited to sit in and were cautioned to be careful of what they wrote.

The complaint by Phillips was first filed in Bartlesville, Okla., on Dec. 22, 1941, and has been kicking around in court ever since.

All charges that Shell infringed on the Frederick E. Frey patent were denied by the company. "The said process was not an invention and was not patentable."

Shell answered to the original claim.

Exhibits in the case showed that Ralph K. Davies of PAW had at one time asked that the case be postponed on the grounds that the trial would "needlessly occupy the time of men who could be more advantageously employed in work connected with the war effort."

Domestic And Foreign Crude Stocks Up 937,000 Bbls.

NPN News Bureau

WASHINGTON — Domestic and foreign crude stocks totaled 215,417,000 bbls. at close of week ended Sept. 22, up 937,000 bbls. from previous week, Bureau of Mines announced.

There was an increase of 1,516,000 bbls. in domestic crude stocks and a decrease of 579,000 bbls. in foreign crude. Heavy crude stocks in California totaled 4,344,000 bbls., down 53,000 bbls. from preceding week.

Major increase in domestic stocks were in Oklahoma, up 1,343,000 bbls., and California, up 324,000 bbls.

Major decreases were in Texas, down 495,000 bbls., and Arkansas, down 91,000 bbls.

GASOLINE CONSUMPTION BY STATES, MAY 1945

(American Petroleum Institute Figures)

	Tax Rate† May Cents	Month of April, 1945 Gallons	Month of May, 1945 Gallons	Month of May, 1944 Gallons	% Change	5 Months Ending With May, 1945 Gallons	5 Months Ending With May, 1944 Gallons	% Change
Alabama	6	22,654,000	24,054,000	22,441,000	+14.38	117,077,000	105,410,000	+11.07
Arizona	5	11,939,000	10,519,000	11,450,000	— 8.13	51,392,000	60,302,000	—14.78
Arkansas	6½	15,760,000	17,062,000	13,994,000	+21.92	78,564,000	71,219,000	+10.31
California	3	420,717,000	410,368,000	270,489,000	+51.71	1,805,196,000	1,334,863,000	+35.23
Colorado	4	21,102,000	25,400,000	29,546,000	—14.03	115,697,000	117,722,000	— 1.72
Connecticut	3	21,803,000	24,035,000	24,394,000	— 1.47	110,822,000	110,948,000	— 0.11
Delaware	4	4,124,000	4,463,000	4,714,000	— 5.33	19,603,000	19,765,000	— 0.82
District of Columbia	3	8,520,000	9,144,000	9,243,000	— 1.07	44,437,000	44,807,000	— 0.83
Florida	7	33,012,000	33,465,000	33,110,030	+ 1.07	168,543,900	163,850,000	+ 2.86
Georgia	6	31,725,000	34,398,000	31,571,000	+ 8.95	162,151,000	152,876,000	+ 6.07
Idaho	6	8,100,000	9,449,000	9,023,000	+ 9.44	36,946,000	34,105,000	+ 8.33
Illinois	3	98,375,000	115,713,000	121,048,000	— 4.41	474,356,000	467,440,000	+ 1.48
Indiana	4	60,827,000	67,421,000	66,632,000	+ 1.18	296,017,000	283,376,000	+ 4.46
Iowa	3	51,959,000	59,101,000	55,226,000	+ 7.02	225,847,000	206,722,000	+ 9.25
Kansas	3	34,921,000	39,367,000	39,218,000	+ 0.38	169,764,000	160,826,000	+ 5.56
Kentucky	5	30,355,000	32,642,000	24,980,000	+30.67	145,479,000	115,345,000	+26.13
Louisiana	7	26,396,000	27,214,000	24,265,000	+12.15	132,100,000	124,376,000	+ 6.21
Maine	4	10,049,000	11,619,000	12,059,000	— 3.65	51,273,000	48,176,000	+ 6.43
Maryland	4	28,219,000	27,411,000	26,172,000	+ 4.73	136,485,000	114,568,000	+19.13
Massachusetts	3	43,764,000	47,952,000	48,187,000	— 0.98	223,646,000	211,278,000	+ 5.85
Michigan	3	93,248,000	93,120,000	99,493,000	— 6.41	453,064,000	410,900,000	+10.26
Minnesota	4	38,570,000	48,482,000	40,643,000	+19.29	185,479,000	169,504,000	+ 9.42
Mississippi	6	16,327,000	21,069,000	16,898,000	+24.68	86,499,000	83,976,000	+ 3.00
Missouri	2	42,856,000	46,228,000	45,008,000	+ 5.42	209,187,000	208,009,000	+ 0.57
Montana	5	11,197,000	12,962,000	11,946,000	+17.01	46,533,000	43,918,000	+ 5.95
Nebraska	5	19,656,000	23,116,000	19,427,000	+18.29	96,104,000	90,105,000	+ 6.66
Nevada	4	4,072,000	3,840,000	4,470,000	—14.09	18,309,000	24,184,000	—24.29
New Hampshire	4	4,964,000	5,519,000	5,725,000	— 3.60	26,059,000	24,108,000	+ 8.09
New Jersey	3	58,278,000	60,744,000	61,747,000	— 1.63	286,138,000	276,714,000	+ 3.40
New Mexico	5	9,990,000	10,335,000	9,630,000	+14.64	47,658,000	44,720,000	+ 6.57
New York	4	109,103,000	116,792,000	124,728,000	— 6.36	542,059,000	549,052,000	— 1.27
North Carolina	6	35,998,000	40,651,000	40,190,000	+ 2.29	174,715,000	170,566,000	+ 2.43
North Dakota	4	15,882,000	24,059,000	23,069,000	+ 4.29	68,704,000	63,936,000	+ 7.46
Ohio	4	121,948,000	123,027,000	119,458,000	+ 2.99	559,918,000	552,146,000	+ 1.40
Oklahoma	7½	40,113,000	48,928,000	37,481,000	+14.53	229,902,000	162,173,000	+41.76
Oregon	5	20,672,000	21,434,000	23,477,000	— 8.70	95,960,000	102,112,000	— 6.03
Pennsylvania	4	95,095,000	101,197,000	103,203,000	— 1.94	458,580,000	457,432,000	+ 0.25
Rhode Island	3	9,565,000	10,538,000	10,149,000	+ 3.83	49,663,000	44,695,000	+11.12
South Carolina	6	16,543,000	17,371,000	16,957,000	+ 2.44	82,888,000	80,203,000	+ 3.35
South Dakota	4	12,979,000	15,158,000	12,270,000	+23.54	55,463,000	46,577,000	+19.08
Tennessee	7	31,289,000	29,724,000	31,255,000	— 4.90	139,287,000	143,305,000	— 2.81
Texas	4	447,536,000	436,886,000	366,017,000	+19.36	2,057,881,000	1,484,164,000	+77.31
Utah	4	8,455,000	9,495,000	7,929,000	+19.75	41,592,000	40,334,000	+ 3.12
Vermont	4	3,440,000	4,105,000	3,879,000	+ 5.83	17,745,000	16,558,000	+ 7.17
Virginia	5	36,865,000	40,109,000	35,442,000	+13.17	186,682,000	168,365,000	+10.88
Washington	5	32,202,000	32,679,000	30,709,000	+19 44	147,498,000	146,678,000	+ 0.56
West Virginia	5	15,685,000	13,325,000	12,349,000	+ 7.90	68,150,000	67,045,000	+ 1.65
Wisconsin	4	44,558,000	48,563,000	44,171,000	+ 9.94	204,835,000	183,663,000	+11.53
Wyoming	4	4,661,000	5,497,000	4,620,000	+18.98	26,292,000	20,921,000	+25.67
Total		2,386,068,000	2,495,750,000	2,240,102,000		11,228,239,000	9,824,037,000	
Daily Average		79,536,000	80,508,000	72,261,000		74,359,000	64,632,000	
Change from previous year:								
Total Change		.....	+255,648,000	.....		+1,404,202,000	.....	
Percentage change in Daily Average		.....	+11.41%	.....		+15.05%	.....	

†These are State tax rates per gallon. In addition there is the Federal tax of One and one-half cents (1½c) per gallon.

CLASSIFIED

For Sale

LUMBER FOR SALE: Oil field timbers. Hardwood surveyor stakes. E. J. Gaiennie Lumber Co. Box 1074, Shreveport, La.

FOR SALE: Transport Granco pump, brand new. $150.00—for $90.00. Call Waterbury, Conn. 3-2147. F. & S. Oil Co., So. Leonard St., Waterbury, Conn.

STEAM-JACKETED KETTLES

1—550-gallon, complete with motor.
1—300-gallon, complete with motor.
In first class condition.

COLT-WORTHINGTON OIL WORKS, INC.
Garden City, N. Y.,
Tel.: Garden City 3430

REFINERY EQUIPMENT FOR SALE:

Towers: Bubble, Flash, Clay, Receivers, Separators, Centrifuges, Tube Stills, Continuous Treating Drums, one Clarke Gas Engine Compressor—100HP—533 Cu. Ft./Minute. Fittings: Ammonia, Brass, Welding, Pipe Hangers.

P.O. Box 610, Mt. Pleasant, Texas

STEAM VULCANIZING EQUIPMENT

9 car molds, 3 truck molds, 26 pair bead plates, 36 car air bags, 6 truck air bags, 3 tube plates, 2 bead cutters, 3 tire spreaders, 1 vertical steam boiler and all other equipment necessary for a tire shop. Send for itemized list.

LINDQUIST OIL CO.
FERGUS FALLS, MINN.

TANK-TRAILER BARGAINS

Fruehauf branches now have a wide variety of late-model used gasoline Tank-Trailers in stock for immediate delivery—many priced well below ceiling. Capacities from 2500 to 5200 gallons. Both single and tandem axle types. Majority were built in 1941 or later. Can be purchased "as is" or completely reconditioned. See your Fruehauf Branch or write

Fruehauf Trailer Company
10940 Harper Ave. Detroit 32, Mich.

FOR SALE

1—GMC AC853 1945 Tractor
1—GMC 477 1945 Tractor
1—GMC 361 1940 Tractor
1—White 20A 1939 Tractor
2—Brockway 240 1941 Tractor
1—Brockway 175X 1938 Tractor
1—5100 gal. tank Fruehauf—1945
1—4300 gal. tank Fruehauf—1944
1—4500 gal. tank Fruehauf—1944
1—4025 gal. tank Fruehauf—1944
1—4000 gal. tank Fruehauf—1943
1—3600 gal. tank Trailmobile—1943
1—3500 gal. tank Heil—1938
1—White one ton Stake truck
1—1937 Brockway with 1250 gal. Heil tank and Neptune meter.

All equipment in A-1 condition. Phone, wire or write

WILLIAM A. EVANS
79 Fillmore Ave. Buffalo 10, N. Y.

For Sale

FOR SALE

Six acres river front property on Ohio river located New Albany Indiana which is across river from Louisville. Ideal for barges and boats also served by Southern R.R. switch, several buildings available on property.

Chester B. Stem Inc.
New Albany, Indiana.

FOR SALE

One tank train of 7,000-gallon capacity. Consists of 1941 two-compartment Fruehauf Semi and 1938 three-compartment Fruehauf four-wheeler. Both in good condition and equipped with 10:00 x 20 tires and air brakes. Price complete—$3500. This equipment is in excellent condition and is a bargain at this price. Must be seen to be appreciated.

SCIENTIFIC BRAKE SERVICE
304 W. Genesee Ave.
Saginaw, Michigan

Wanted to Buy

WANTED: 800-1000 gallon 3 compt. fuel oil truck fully equipped. Ice Service Company, Clayton, Del.

WANTED

STEEL TANKS—5000 to 25000 gallons each.

BOX 700

WANTED:

To buy fuel oil company centrally located in Chicago, including bulk plant, trucks and business. Will pay cash.

Box No. 800
National Petroleum News
59 E. Van Buren St.
Chicago 5, Ill.

WANTED

2—Gasoline air compressors.
10—¼, ½, or ¾ HP air compressors.
25—Used computing pumps (working shape).
5—Electric Meter pumps (working shape).
1—800 gal. 5 comp. streamlined tank.
1—1000 gal. 6 comp. streamlined tank.

Give best price and full details first letter.

VAN BUREN OIL COMPANY
ATHENS, GEORGIA
P.O. BOX 600

Situations Open

SALESMAN: Distributor in Eastern Penna. requires a salesman. State salary desired and qualifications. Box 704.

SALESMEN. Well established independent refinery entering marketing field has opening for two experienced sales representatives familiar with petroleum products and acquainted with Middle West and Southwest territories. Box 701.

Situations Open

WANTED SALES MANAGER

For large independent distributor in metropolitan New Jersey territory. Must be aggressive with experienced background preferably in the East. Good salary for the right party. Applicants state full details together with age. Reply—

Box 565

Oil Equipment Salesmen

Butler needs sales engineers in various territories from the Rocky Mountains to the Atlantic Coast.

Butler Truck Tanks
Butler Transport Tanks
Butler Storage Tanks
Butler Steel Industrial Buildings
Butler Steel Service Stations

Tremendous backlog of equipment needed by the industry. Butler Oil Equipment a leader in the field. Backed up by national advertising. Attractive compensation for men who produce.

Inquiries solicited from experienced Oil Equipment men. Give age, present connections, past contacts and territory preferred. Salesmen now in the Armed Forces who have seen Butler Products in use around the world are also invited to write giving full information.

G. A. Burns, Mgr. Oil Equipment Division
BUTLER MFG. COMPANY,
7454 E. 13th St., Kansas City, Mo.

Positions Wanted

VETERAN TO BE DISCHARGED in week with over ten years merchandise and sales experience. Single, personable, aggressive; wants job in sales capacity in Chicago or vicinity where initiative will be recognized. Box No. 699.

SERVICEMAN, 23, expecting discharge before Christmas seeks position in sales department of a reliable oil company. High school education and fifteen months experience as a station attendant. Army career has been radio operating and truck driving. Prefer Cleveland area. Box 706.

EX-SERVICEMAN, 29, with 8 years previous experience, 3½ years in production and 4½ years in refinery, would like to get back into production on the Illinois field. High school and one year college. Box 705.

NAVAL LT., 31, discharged soon. Graduate engineer with 4 years experience sale and promotion petroleum products Major oil company. Interested in industrial management and sales engineering. Desires responsible position commensurate with ability. Box 703.

SALES EXECUTIVE wishes to invest $5,000 plus services in small going concern, preferably in south. He is a 33 year old veteran; discharged with honors; well educated; versatile; of proven managerial and administrative ability. Twelve years of intensive, well rounded petroleum experience with major, independent and Government. Box No. 692

NAVAL OFFICER, thirty-four, available by November, desires sales and technical service with independent refiner. Graduate chemical engineer, nine years refining experience; laboratory, process control and technical service. Three years in Navy, duties in connection with procurement and shipment petroleum products. Box No. 670.

CLASSIFIED

Positions Wanted

LT. COLONEL, 34, 12 years executive sales staff international petroleum marketer, 4 years supervision world-wide petroleum distribution Army Air Forces. widely known among Washington Army and Navy personnel. B. S. and M. A. specializing marketing and industrial relations, desires position where experience and ability useful. Finest references. Box No. 697.

NAVY LIEUTENANT, 40 years of age, with cash to invest, desires commission agency with major oil company operating in Eastern or Southern states. Experience, 15 years as territory manager of tankwagon sales and bulk plant operation with a major oil company and 3 years in the procurement of all types of petroleum products for the Navy. Box 707.

ARMY OFFICER, 36, expecting discharge soon, interested in making permanent connection with independent or major oil company. Ten years experience in petroleum marketing prior to war service, including sales, service station supervision, bulk plant commission agent and truck transport. Three years Army experience as Statistical Control Officer in the Air Transports Command, both in the USA and overseas. Box No. 695

MARKETER: Proven ability in Management, Operation, Sales and Development of Jobber, Terminal and Dealer Business and groups of conventional, super and volume service stations. Background twenty years broad experience in responsible positions and fair knowledge of phases other than marketing, 43 years old. Available reasonable notice. Would like to present qualifications for position to marketer or independent refiner preparing for post war competition. Box No. 644.

GAS AND WATER TREATING ENGINEER with 12 years experience in natural gasoline industry desires position in technical capacity. Varied experience in analytical procedures, plant operation, water treating with internal and external softeners, sweeting gasoline and gas, dehydration, and supervision of laboratory and plant control. Married, one child school age. Desire location where adequate housing and school facilities are available. Excellent references available. Box 702.

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"Position Wanted"—10 cents a word. Minimum charge $1.50 per insertion.

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ABOUT OIL PEOPLE

J. W. Connolly has been named head of a newly formed marketing council department of Standard Oil Co. (N. J.), it was announced last week by **Eugene Holman,** president. Mr. Connolly was also appointed vice-chairman of the marketing council, Central Sales Group, of the Jersey company.

Mr. Connolly

Mr. Connolly has had many years' experience in directing sales of petroleum products while an official of Standard Oil Co. of New Jersey. In the war he was chairman of the Fuel Oil Subcommittee of PAW Dist. 1.

° ° °

Richard Fenton, executive vice-president of California Stripper Well Association, has been appointed to the National Crude Oil Advisory Committee of the Office of Price Administration. Mr. Fenton is also chairman of the California Stripper Well Advisory Committee of OPA.

° ° °

Appointment of **John O. Larson** of the co-ordination planning department as an assistant secretary of Standard Oil Company (N. J.) was announced today.

Mr. Larson lives at Roslyn, L. I., and has been with the company since 1927, starting as a clerk. All his service has been in the co-ordination and economics department where he has participated in studies used in the preparation of world-wide operating programs of the Jersey affiliates. He will be an assistant to **A. C. Minton,** secretary of the company, at 30 Rockefeller Plaza, New York.

° ° °

Major Alexander Forward has resigned as managing director of the American Gas Association, it was announced recently by the association's Executive Board.

Major Forward joined the association in 1923 as secretary-manager; four years later he was appointed managing director.

° ° °

J. P. Shaff has joined Sunray Oil Corp, as sales manager, according to announcement by F. L. Martin, vice president in charge of refining and sales.

Mr. Shaff, whose appointment was effective Sept. 15, comes from Bartlesville, Okla., and has had 18 years' experience in the petroleum industry. He was educated at Oklahoma A. & M. College at Stillwater, and has since been connected with Phillips Petroleum Co. in sales and distribution.

ABOUT OIL PEOPLE

Mr. Metz

Mr. Bale

Mr. Cuthbert

Appointment of **C. H. Metz, Jr.**, to be director of industrial relations for The Standard Oil Co. (Ohio) was announced last week by **W. T. Holliday,** president.

Mr. Metz will be succeeded in his former position as manager of Sohio's No. 1 refinery by **J. R. Cuthbert,** who has been superintendent of Standard's Lima refinery.

I. L. Peterson will succeed Mr. Cuthbert, and **E. S. Bale** has been named as superintendent of No. 1 refinery. Mr. Peterson before his promotion was superintendent of maintenance and construction at the No. 1 refinery. Mr. Bale who has been superintendent of process, in addition to his new responsibility, will continue as superintendent of process.

Mr. Metz joined Standard Oil Co. of New Jersey in Charleston following his graduation from the Citadel at Charleston, S. C. in 1922. He remained with Jersey Standard for two years, then spent three years in Tampico, Mexico. He came to Cleveland in 1927 as a cracking coil stillman at Sohio's No. 1 refinery. A year later he was made coil foreman, and in 1929 assistant superintendent. He was named superintendent of the refinery in 1937. Following the refinery's expansion last fall he was appointed to the newly created position of manager.

Mr. Cuthbert represents the third generation of his family in the petroleum industry. His grandfather owned a small refinery before the formation of the Standard Oil Co. (Ohio) 75 years ago.

After taking a specialized chemical course at the Rensselaer Polytechnic Institute, Mr. Cuthbert joined Grasselli Chemical Co. in Cleveland. For three years he operated an industrial laboratory in Lima, and in 1925 joined Solar Refinery Co., later purchased by Standard Oil.

Mr. Peterson joined Sohio's Toledo refinery as a draftsman following his graduation from the University of Illinois in 1924. His experience includes being a boilermaker's helper, boiler shop foreman, and the supervision of construction of cracking coils.

In 1936 he became assistant to **G. W. Hannekin,** vice president in charge of manufacturing. He was made superintendent of maintenance and construction in 1944.

Mr. Bale joined Sohio in 1939 as process engineer at the Toledo refinery, and the same year was transferred to the home office in Cleveland as chief of the technical service section of the manufacturing department.

° ° °

Two employes of the Humble Oil and Refining Co. received the diamond 20-year service emblem during the same month. They are father and son—**G. L. Waddell** and his son, **Willard M. Waddell.** The senior Waddell is a millwright at the Baytown refinery and the son is safety engineer for the Ingleside refinery.

° ° °

V. F. Fusion has opened a Texas office in Forth Worth for the Ashland Oil and Refining Co. of Ashland, Ky.

° ° °

California's oil industry was praised by OPA at a meeting in Los Angeles. A certificate of award was presented to **George B. Hargens,** chairman of the Petroleum Products Industry Advisory Committee for PAW. The scroll was presented by Charles R. Baird, OPA regional administrator, to Mr. Hargens. In making the presentation Mr. Baird said that of 63 such committees in the nation only ten had received the award.

G. R. (Ray) Fenner, for the past eight years in charge of the Columbus, (O.) zone for Pure Oil Co., has been promoted to the position of marketing co-ordinator for Pure, with headquarters in Chicago.

He will be succeeded as Columbus zone manager by **J. E. (Ed) Jones,** former Columbus district manager, who for several years has served as the company's zone manager at Parkersburg, W. Va.

° ° °

J. A. Kearney has been promoted from traffic manager to chief clerk at Chalmette Petroleum Corp.'s Chalmette, La., refinery, an announcement from Bay Petroleum Corp., parent company, states.

° ° °

K. O. Stowell, who was operating superintendent of Great Southern Corp.'s 100-octane aviation plant at Corpus Christi, Texas, has been appointed superintendent for Chalmette Petroleum Corp.

Following his graduation from the University of Colorado in 1930, Mr. Stowell entered the oil business as student engineer on operation, pilot plant and laboratory work with Humble Oil & Refining Co. at Baytown, Tex. He was advanced steadily through Humble's technical service department, becoming technical supervisor at the company's Ingleside (Tex.) plant, refining department process engineer, and operating superintendent of the butadiene plant in 1942.

° ° °

Dr. E. H. Sellards, retiring director of the Bureau of Economic Geology at the University of Texas, was paid a tribute by the Dallas Petroleum Geologists in a recent session for "protracted and unselfish efforts in advancing the science of geology and assisting practicing and academic geologists by contributing a fund of technical information that otherwise would not have been available." Dr. Sellards will be replaced by **Dr. J. T. Lonsdale,** recently discharged from the Army intelligence branch and formerly with the geology departments of A. & M. College of Texas, Iowa State College and the University of Oklahoma.

° ° °

Three out of 100 North Carolina sheriffs are oil jobbers, **W. A. Parker,** secretary of North Carolina Oil Jobbers Assn., writes in a recent copy of that organization's weekly bulletin.

J. E. Winslow, owner of Winslow Oil Co. at Hertford, has been Perquimans County sheriff for many years. **H. M. Clark,** president of Sampson-Bladen Oil Co., of Elizabethtown and Clinton, holds that office in Bladen County. Latest oil man to join the ranks of sheriffs is **Hoyle T. Efird,** proprietor of Gastonia United Oil Co., Gastonia.

SURE THE WAR IS OVER . . . . BUT!

SURE, we have started manufacturing National Pumps again. But materials are still scarce and shipments are necessarily slow. We hear it's the same in every line of business.

You can be assured that just as soon as necessary materials are available you will receive the new National Pumps you have ordered.

To you, who have *not* yet ordered, may we suggest that you place your orders now for desired 1946 monthly requirements!

MECHANICALLY CORRECT

NOTE: Additional equipment agents and jobbers needed to sell our complete line. Correspondence is invited.

NATIONAL PUMPS CORPORATION

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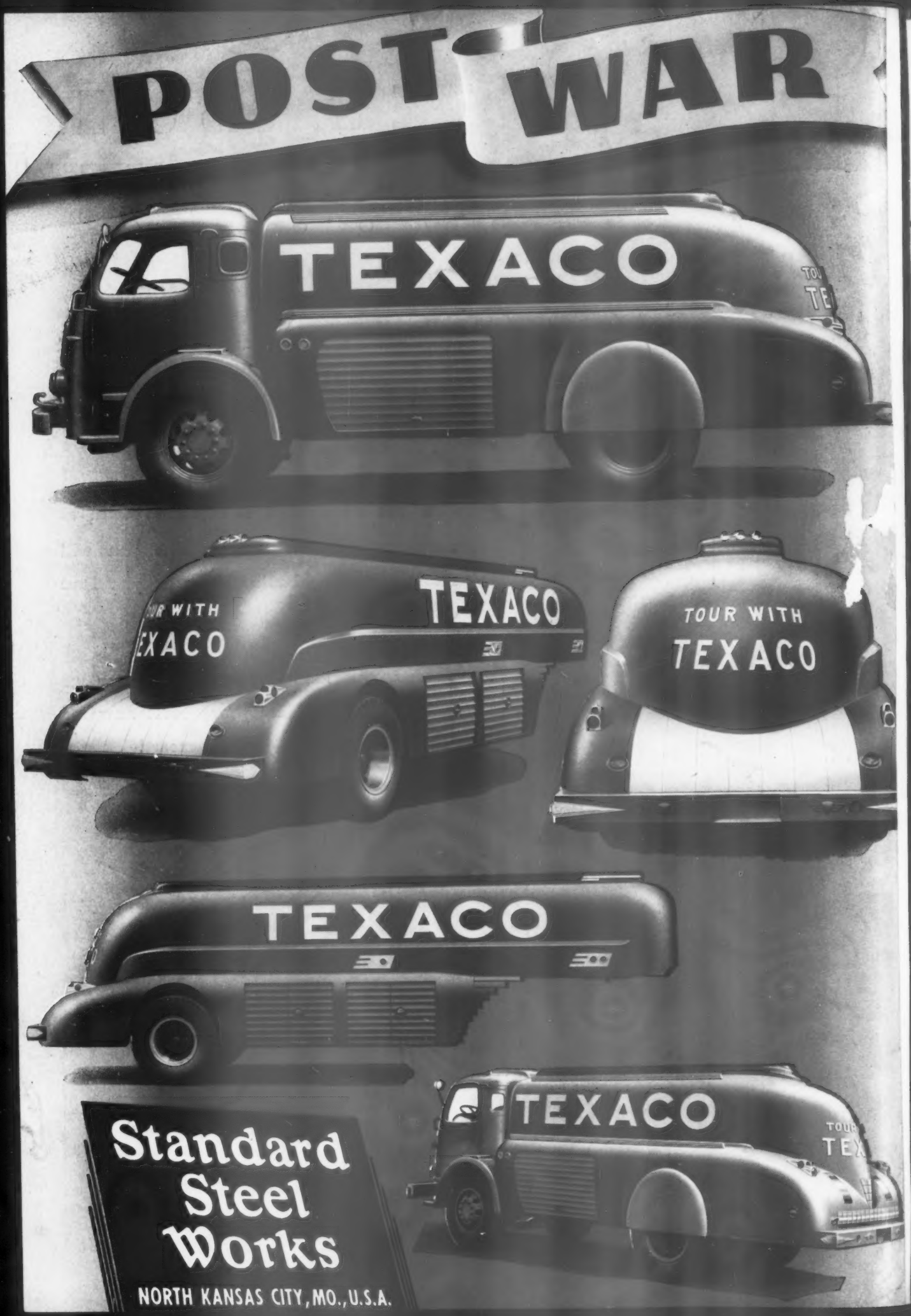
Pacific Coast Division: 79 New Montgomery Street, SAN FRANCISCO, CALIF.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OCT 5 1945

NATIONAL PETROLEUM NEWS

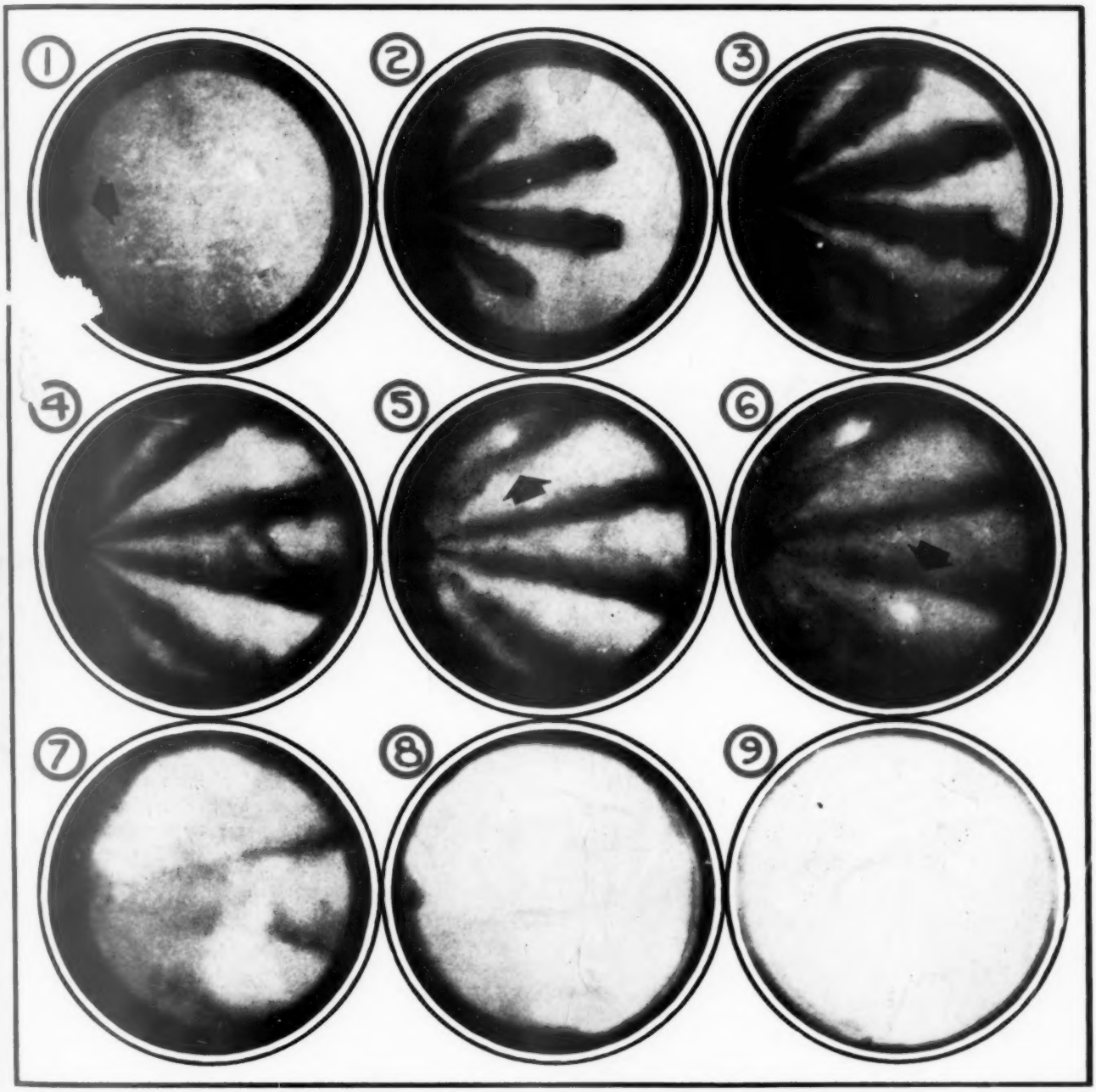
Monthly Technical Section Devoted to

REFINERY MANAGEMENT and PETROLEUM CHEMICAL TECHNOLOGY

Section Two

October 3, 1945—Vol. 37, No. 40

Slow-Motion Pictures Aid Study of Diesel Fuel Combustion



Shown above are selected frames from a sequence of motion pictures showing the injection and non-knocking combustion of fuel in a Diesel engine cylinder. By means of a new high-speed camera developed in the National Advisory Committee for Aeronautics laboratory in Cleveland, photographs are taken at the rate of 40,000 a second, to be reproduced in slow-motion. No. 1—fuel is just beginning to enter the cylinder at the left. In No. 2 six distinct jets of fuel are clearly visible and have almost completely crossed the cylinder in No. 3. No. 4—intermixing of the jets. Combustion is first visible as a single bright spot in No. 5, 104 frames (.0026 sec.) after injection began. A fraction of a second later (No. 6) another bright spot indicates a second point of combustion. The flames spread rapidly in Nos. 7 and 8, and have reached their peak intensity in No. 9, 94 frames or .00235 sec. after burning was first apparent

For details of this new high-speed camera technique and the complete sequence of pictures, see page R-773.

REPEAT PERFORMANCE

Trinity Gas Corporation Plant
Sejita Field, Duval County, Texas—1945

Trinity Gas Corporation Plant
Long Lake, Texas—1939

Typical of the many repeat performances by Hudson, for the same client, is the recently completed cycling plant of Trinity Gas Corporation at Sejita, Texas. It far exceeds in size and variety of products, the small Long Lake plant completed for the same owner in 1939, but embodies the same high quality of engineering and construction.

◆ ◆ ◆

HUDSON ENGINEERING CORPORATION

Engineers and Constructors

HOUSTON, TEXAS

FAIRVIEW STATION

Gas Compressor Stations • Cycling Plants • Gas Dehydration Plants • Natural Gasoline Plants • Fractionation Units • Hydrogen Sulphide Removal Plants • Mechanical and Natural Draft Cooling Towers.

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PREVIEW

Feature Articles Coming Next Month

Manufacture of Fertilizers From Natural Gas

One of the few nitrogen fixation plants ever to be operated by an oil company is described, based on a visit to the Ozark Ordnance Works by a staff writer. This plant, which uses the latest process for synthesis of ammonia from its elements, derives the necessary hydrogen from natural gas, the only raw material purchased.

The facilities of this $30,000,000 installation near El Dorado, Ark., built by Army's Ordnance Department, are expected to be operated by Lion Oil Co. through a subsidiary, Lion Chemical Corp., for the manufacture of ammonium nitrate fertilizer. Some of the possibilities in the way of chemicals to be derived from ammonia and the two by-products of the process, carbon monoxide and carbon dioxide, are given.

Exclusive in the November issue of the TECHNICAL SECTION.

Sulfur and Sulfur Chloride Reaction Products as Additives

(Second Article of a Series)

A review of the use of sulfur and sulfur chloride organic reaction products as lubrication additives traces the progress in this field since the first patent disclosure on the subject in 1868.

This article, exclusive in the November TECHNICAL SECTION, is the second in a series by George G. Pritzker, a chemical engineer in the U. S. Patent office. The first article, "Sulfonic Derivatives", appears in the current issue, pg. R-793.

Inspection of Refinery Electrical Equipment

Electrical equipment around a refinery should be inspected periodically from the viewpoint of maintaining continuity of service and protecting individuals and property. Recommended procedures for such inspection work and methods of determining safe limits are outlined in Part 2 of the PAW Refinery Inspection Manual in the November TECHNICAL SECTION.

A.S.T.M. Symposium on Neutralization Number

Present methods of determining neutralization number for lubricants were reviewed recently in a symposium sponsored by the A.S.T.M. The discussion sought to find out whether or not present methods of determination give the information desired by large oil consumers, and how the methods might be improved. A review of the viewpoints of the industrial, turbine and automotive engineers is included in the report on the symposium.

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Chrysler Building, New York 17, N. Y.

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REFINERY MANAGEMENT *and* PETROLEUM CHEMICAL TECHNOLOGY

Oct. 3, 1945
Volume 37
Number 40

MONTHLY TECHNICAL SECTION OF NATIONAL PETROLEUM NEWS *incorporating International Petroleum Technology*

Germany's Progress in Straight Refining Is Reported Inferior to U. S. Advances

By William F. Bland

Engineering Editor, NPN Technical Section

WASHINGTON

GERMAN methods of straight refining of crude oil and producing high-quality products during the war were far less efficient than those commonly used in this country, according to expert oil technologists who have been investigating defeated Nazidom's industry. However, the Germans' technological progress in the manufacture of synthetic fuels and lubricants was much more rapid.

Catalytic cracking on a commercial scale was virtually unknown. Germany's peak production of aviation gasoline was less than a tenth of ours. The octane ratings of both their motor and aviation gasoline were considerably less than our standard 80 and 100-octane fuels.

From the small amount of technical data which has already been brought out of Germany by the investigators and released by PAW it is possible to put together a rather generalized picture of the extent to which they had developed petroleum refining and synthesizing facilities. The bulk of the German data, however, hasn't been analyzed and catalogued as yet; the final story will have to wait until further reports are released.

For the most part, because of shortages of natural resources, German scientists devoted the bulk of their efforts to synthesizing or producing "ersatz" products.

During the war, the Germans increased their synthetic production of petroleum products considerably. It is estimated that at the start of hostilities in 1939 only about a third of all their petroleum products were obtained by synthesis, the remaining two thirds being manufactured by the usual refining of natural crude oil.

At the peak of their production, which appears to have been reached in the spring of '44, just prior to the large scale air raids which were inaugurated in April of that year, they had about tripled their synthetic output. At that time they were depending upon synthesis for over 60% of their supplies, with crude petroleum being the source of only 40%. At this peak period, however, their production of aviation gasoline was still less than 10% of our production of more than 500,000 b/d.

The Germans had two grades of aviation gasoline—bomber and fighter. On rich octane rating both were fairly comparable to our 100-octane fuel, since they had a high content of aromatic hydrocarbons, which boost the rich rating. On the lean rating, however, their bombing grade was comparable to about a 91-octane and their fighting grade to a 95-octane. The Nazi produced some ingredients for 100-octane gasoline, but not in sufficient quantity to bring all the gasoline they needed to that standard.

These lower ratings weren't as serious to the Germans as it at first sounds, however. They reportedly had done considerable research work on engines and as a result were able to alter various design factors of their aircraft engines to obtain service which was in some cases comparable to what we were able to get with better fuels. For trucks and tanks, they were forced to use a fuel of a lower rating than the 80-octane supplied ground transport in the American Army.

The Germans had done a great deal of research and development work in catalytic cracking, it is reported, but they never had any actual production units in operation. Many were in the design stages, and some even under construction, but even their most advanced unit was less than 50% completed when V-E day came. The nearest they approached anything resembling commercial operation was a small pilot plant with an estimated through-put of 100 to 200 b/d.

Two catalytic cracking processes were being developed—one by I. G. Farbenindustrie and the other by Ruhr Chemie. I. G. used a moving bed of pellet type catalyst, which in many respects was similar to the T. C. C. method employed in this country. Operation was continuous, with separate reaction and regeneration vessels. The catalyst was moved through the vessels by gravity, and from one vessel to the other by mechanical conveyors. Operating conditions of temperature and pressure were within the range of our own operations. Ruhr Chemie used a fixed-bed process.

The Germans don't appear to have been particularly interested in pushing the development of catalytic cracking. In the first place their processes for coal hydrogenation and subsequent hydroforming seem to give satisfactory base stocks. In the second place they were limited in the supply of crude oil from which they could make charge stocks for any catalytic cracking units.

They even performed comparatively little thermal cracking, according to reports, confining their operations on crude petroleum often to simple topping. PAW doesn't expect that U. S. industry will be able to profit greatly by the German work along the lines of catalytic cracking.

In general, the Germans had developed just about the same supplementary processes as we have been using for producing gasoline blending agents, including butane isomerization, alkylation, hydrogenation and hydroforming.

In the field of alkylation, the Germans were definitely behind us in their development and research work. They employed sulfuric acid as the catalyst in all of their plants, but had no commercial plants in operation using anhydrous hydrofluoric acid as the catalyst.

Their aviation gasoline base stock was blended with small amounts of alkylate and isopentane. TEL was also used in the proportion of about 4 or 5 cc per gal. Nothing appears to have been developed which was any better than TEL as an additive to improve the anti-knock characteristics of a gasoline, or at least nothing which was commercially practical.

Two gasoline additives were developed, however, which it was claimed would prevent the corrosion of internal combustion engines when injecting water into the intake by depositing a rust inhibiting film on exposed parts. These were made from (1) dodecylphenyl chloride condensed with glycine (cyclohexylamine salt) and (2) iso-butyl cyclohexyl butyric acid (cyclo hexylamine salt).

The Bergius process for the hydrogenation of coal seems to have been preferred in the synthetic fuel field for producing aviation base stock, the reaction

products often being passed through a hydroforming unit to increase octane number. The octane number of the treated base stock which resulted after hydroforming was in general comparable to what we produced by means of catalytic cracking. It had a clear octane rating (ASTM method) of about 80.

The hydrogenation plants are reported to have been operating at surprisingly high pressures—in the range of 1000 to 1100 psi.

The Fischer Tropsch method of synthesis was employed to some extent, yielding some motor gasoline and a good grade of diesel fuel. It was the stepping stone, also, in the production of a tremendous quantity of special chemicals.

The Germans are reported to have developed two main methods of producing synthetic lubricants. One was the polymerization of ethylene with an aluminum chloride catalyst; this process yielded about 500 tons per month. The other process involved the cracking of wax produced by the Fischer Tropsch reaction. The cracked products were subsequently polymerized with aluminum chloride to yield oil of lubricating quality.

In the way of lubricant additives, a polyisobutylene was used to improve viscosity, and polyvinyloleyl ether and its copolymers with vinyl isobutyl ether were reported to be outstanding pour point depressants for mineral oils. Calcium benzoate (2%) was added to tropical greases to increase the melting point.

Oil-bearing shales were used to a slight extent to supplement Germany's sources of petroleum products, and PAW expects that the U. S. petroleum industry will be able to learn something from their developments along those lines.

The Germans appeared to have started a concerted effort to move their refining facilities underground, but less than 10 refineries were in actual underground operation with many more in various phases of completion.

For the most part they seem to have confined their efforts to moving underground the refineries processing crude, although they apparently also had plans to move at least one hydrogenation plant underground. The reason for this selection was probably dictated by safety factors. Much of the equipment in the synthetic plants was operated under tremendous pressures. If mechanical failure had resulted in the explosion of any of this equipment in the confined underground area the results would probably have been disastrous to the entire installation.

Their method of installing a refinery underground consisted for the most part of selecting a cliff or steeply-faced mountain side; they would then excavate horizontally into the side of the hill or mountain to whatever extent was necessary. In effect they had a huge cave with one side open. Such an installation presented a difficult bombing target, and afforded the protection of the mountain top immediately above the unit.

Excavating a hole large enough to accommodate the many high fractionating towers of a modern U. S. refinery would be a tremendous task, so the Germans cut down on the height of their towers. Instead of using one tower with 50 trays they would install two 25-tray towers in series.

It doesn't appear that the Germans had developed any particular methods of protecting refineries against air raids, other than the usual anti-aircraft installations and fire-fighting equipment. Instead, they always had a large supply of extra and spare parts on hand and an equally large labor force living in the immediate vicinity. Immediately following a raid, the labor force would swarm into the destroyed areas and get the units back on stream in a surprisingly short time. They must have had a discouraging task, however, since invariably another air raid would shortly put the unit out of commission again.

The bulk of the information which is available on German refining and oil production methods has been gathered by a group of leading American oil technologists who followed advance elements of the American armies in order to reach the German oil centers before records could be removed and destroyed.

Tons of these records have been recovered from laboratories and refineries in the occupied territory, and are now in England being microfilmed for transmission back to the U. S.

PAW plans to make the information available in this country in two forms. Those companies who wish to make their own translations may obtain copies of the microfilms of the original German text, selecting the subjects of interest to them from an index being prepared by PAW. In addition, copies of the microfilms are being turned over to the Technical Advisory Committee of the Petroleum Industry War Council for translation and evaluation. TAC will prepare summary reports, which will then be made available to the industry.

Although PAW had originally planned to handle the release of this material itself and only on a restricted basis, since the capitulation of Japan a central clearing organization has been established in the Department of Commerce to handle all enemy scientific and technical data and disseminate it as widely as possible.

It is known as the Office of the Publication Board, and is under the direction of J. C. Green.

In a recent interview with NPN, Mr. Green estimated that it might be at least three months before even a dent had been made in the tons of data that have been captured.

"We will get the material back here, abstracted and catalogued just as quickly as we can," he asserted. "Our main job at present is to get an organization set up that can do the job quickly. The information is vital to this country's reconversion and speed is of the utmost importance."

The job of obtaining the information, according to Mr. Green, has been complicated by the fact that the investigators were not the first ones on the scene. "By the time the investigators finally got their hands into the pie a good many cuts had already been taken."

As to Japanese data, no inkling has yet come out as to what General MacArthur's policy will be with regard to gathering and releasing it. It is expected, however, that it should be in much better shape and that there will not be so much competition in obtaining it.

On the other hand, there is doubt in some quarters as to whether or not the Nips have much information of value which isn't similarly available in Germany—unless the latter source has been destroyed.

Mr. Green warned that, although this enemy information should be made available to all U. S. citizens interested in it, "their use of it must be and is at their own risk insofar as the U. S. or foreign patent violations are concerned."

1100 b/d Refinery Operates Underground

One underground German refinery that was in actual operation was located at Ebensee, Austria, in the heart of the Tyrolean Alps and about 45 miles east of Salzburg.

According to George R. Reiss, editorial correspondent for *Steel*, it has a capacity of 357,142 bbls. of crude oil per month, or slightly more than 1100 b/d.

Construction of the Ebensee refinery began in August, 1943, with 8000 slave laborers blasting and digging their way into the side of a mountain. The main chamber which they hollowed out was 102 ft. high, 35 ft. wide, and over 700 ft. deep.

"The plant was originally intended as an ME-262 assembly plant," Mr. Reiss reported, "but the Nazis, desperate for gasoline as a result of air attacks on refineries, decided to switch it when the chamber was nearly finished. They brought in Dr. Fritz Staiger, a leading German refinery engineer, and put him in charge.

"It was intended at first to build 12 separate refinery units in the mountain; the first was completed Feb. 10, and the second a few days later; two more were completed since then, but the Nazis never got around to the others."

The refinery, when Mr. Reiss saw it, was still in operation and "supplying much of the gasoline, lubricating oil, diesel oil, fuel oil and other refinery products being used by the American occupational forces in Europe."

Laboratory Procedure for . . .

Evaluation of Lubricating Oil Crudes

By V. A. Kalichevsky

A simple method is presented which permits an estimation of the composition of lubricating oil fractions of crude oils in terms of the four basic components: asphalt, wax, undesirable oil and desirable oil fractions. Yields of various viscosity index oils for different solvent treating processes can be estimated with reasonable accuracy from the resulting laboratory data. Reporting in terms of ultimate yields provides an incentive for commercial plants to improve their operating efficiencies to give better yields.

A RAPID laboratory analysis of crude oils for their lubricating oil content is of much importance in securing an overall operating economy and providing satisfactory charge stocks for refinery units. Although engine and field testing are indispensable for establishing the ultimate value of high grade lubricating oils,[1] a considerable amount of important information may be obtained from inspection of physical properties of products, which will be of much importance in making a preliminary selection of stocks for further studies.

Several methods were proposed in the past for estimating yields of specification products on the basis of single-stage solvent extractions. These methods involve the use of a constant volume of fresh solvent required to maintain a substantially constant concentration of oil in the extract phase[2], or application of special diagrams for extrapolating or interpolating the experimental data obtained from relatively few laboratory or plant data[3]. These methods are usually somewhat tedious and present many difficulties for practical applications. For this reason a convenient and simple procedure has been developed which is based on a few reasonable assumptions which appear justified in the light of current experiences.

In working out the details of the procedure attempts were made whenever possible to secure data representing ultimate yields of desired products. The plant yields can be approximated by multiplying ultimate yields by an efficiency factor which varies both with the design of each individual unit and the degree of loading. These factors must be determined on the basis of plant experiments. Contrary to prevalent opinions, operation of some extraction systems at less than their maximum capacity frequently reduces their efficiency, suggesting that such units should be operated at full load even if this necessitates their occasional shut down because of shortage of charge stocks.

Additional advantage in reporting ultimate yields arises from the fact that the refinery is then constantly aware of the possibility of improving operations. On the other hand, no attempts for improvement would be made under normal circumstances if the laboratory yields are automatically adjusted to plant yields without reporting actual discrepancies. Fortunately, recent developments in laboratory technique permit securing in most instances better results than those obtained in plant practice.

Crude Oil Split

When the crude oil is received by the laboratory, it is first split into various fractions. This split is done on the basis of the procedures established by the individual plants and is determined on the basis of viscosities and flash points or similar physical properties of the fractions. The distillation procedure should approach as closely as possible the true boiling point analysis in order to insure the best possible approximation of yields of individual products under ideal fractionating conditions. Depending on plant practice, the resulting products may or may not contain asphalt which introduces some variations in subsequent refining technique. The following discussion is confined to asphalt bearing residual stocks but is equally applicable to asphalt-free distillate stocks by omitting the deasphalting step.

A residual lubricating oil stock is usually assumed to contain four distinct components: asphalt, wax, undesirable oil and desirable oil[4]. Because of the existence of a large number of intermediate compounds, separation of the desirable oil fractions presents many difficulties requiring acceptance of certain assumptions for simplifying practical approach to the problem.

Asphalt may be separated from the oil by employing one of the deasphalting solvents such as propane or higher alcohols. Analytical methods involving separate determinations of asphaltenes and resins, the two major constituents of asphalt[5], are of little value in laboratory evaluations because of the arbitrary methods involved in their determination and inclusion of some of the resins in the refined products[6]. In crude oil evaluations the deasphalting procedure should be developed so as to insure excellent reproducibility of the results obtained and a reasonable separation of asphaltic constituents. The actual extraction conditions are determined on the basis of conventional diagrams developed for a typical crude oil and applied to all other crude oils under investigation without correcting for possible variations in their individual characteristics.

Wax is separated from the oil, preferably prior to deasphalting. This is done because the quantity of wax removed with the asphalt is often considerable, particularly with respect to the high melting point fractions. Dewaxing is carried out employing one of the several well-known quantitative laboratory procedures adopted for large size samples. Solvents such as mixtures of methyl ethyl ketone and toluol, or chlorinated hydrocarbons are well suited for this purpose. Dewaxing conditions should be adjusted on a typical sample of crude oil so as to obtain some predetermined pour test on the deasphalted and solvent refined sample. This procedure should be well standardized. However, the pour point of the deasphalted and dewaxed samples of unknown oils may show occasionally some differences as compared to normal crudes. If the difference is greater than 5°F. additional quantities of wax should be removed either by lowering the extraction temperature on dewaxing the original sample or by redewaxing the solvent refined sample. In either case the necessary correction is applied to the wax content of the sample.

Extraction With Solvent

The dewaxed and deasphalted sample is then subjected to a single stage extraction with a solvent. The quantity of solvent is adjusted so as to obtain approximately the specification viscosity index on the reference crude oil sample. Extractions should be made employing the lowest practical extraction temperatures and largest possible quantities of solvent. The procedure, after it is once established, should not be altered.

The laboratory data will vary depending on the conditions and nature of the selected procedures but, as an illustration,

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TABLE 1—Typical Analyses Of Crude Residua

Crude Oil	A	B	C	D
Wax, % vol.	16.2	7.5	8.2	14.0
Asphalt, % vol.	12.7	9.8	8.2	6.0
Undesirable oil, % vol.	43.0	42.4	41.2	26.7
Desirable oil, % vol	28.1	40.3	42.4	53.3
SUV 210°F.	123	114	119	83
Viscosity Index	90	93	94	106
Vis. Gravity Constant	0.820	0.813	0.811	0.804
Flash, °F.	500	500	500	500
Pour, °F.	25	20	20	20

typical crude oil analyses are presented in Table 1.

Interpretation of the results of single batch extractions to multi-stage extractions can be secured by employing certain assumptions which appear reasonable from the practical point of view. Although distribution of the individual viscosity index constituents varies between different crude oils, within a narrow viscosity index range the relative distribution of the individual viscosity index constituents may be considered similar for all crudes at their average viscosity index levels. Likewise the solubility characteristics of the individual oil fractions can be assumed to vary in the same gradual manner.

The second assumption implies that the ratio of solvent employed in single and multi-stage counter-current extractions varies with the ratio of the two phases. The relation depends on the conditions employed in the two types of extractions and should be determined by the individual laboratories. In making these comparisons highly efficient multi-stage laboratory counter-current equipment should be used as well as the actual plant equipment. For translating single-batch laboratory extraction data into commercial or ideal operations, the observed yields are multiplied by the factors obtained from such curves.

Estimate of Composition

The first assumption permits adjustment of laboratory data to a common viscosity index level. Within a narrow viscosity index range, inspection of a large variety of crude oils shows an approximately 2% loss in yield for every point gained in viscosity index. This is based on the dewaxed oil yields. Likewise, within a narrow pour point range, an increase of 5°F. in pour point may be considered equivalent to a gain of one viscosity index unit for medium viscosity oils.

The above method permits an easy estimate of the composition of lubricating oil fractions in terms of the four basic components. Yields of various viscosity index oils by different solvent treating processes may be estimated with reasonable accuracy by adding or subtracting the quantities of the individual components which would appear in the two phases. For instance, in a dewaxing process the yield will be equivalent to the calculated figure obtained by assuming a certain per cent of oil in the wax cake. This yield is based, obviously, on the production of an oil of the aforementioned pour point. In a double-solvent process the raffinate phase will consist of the desirable oil constituents, adjusted to the viscosity index level desired, and wax. Similar considerations hold for the other solvent refining processes.

The following example illustrates the method employed for calculating yields from laboratory data shown in Table 1.

Example of Calculation

Assume that the residual oil from Crude A in the above table is Duo-Sol extracted and dewaxed. In the Duo-Sol extraction process asphalt and undesirable oil are removed in the extract phase while wax and desirable oil concentrate in the raffinate. The ratio of undesirable oil to desirable oil, which may be called "phase ratio" is

$$43.0 : 28.1 = 1.53$$

Referring to a specific curve developed on the basis of the selected laboratory procedure and plant performance a correction factor is determined from this phase ratio. Assuming that the particular reference curve gives us a value of 1.235, the quantity of oil of 90 viscosity index present in the raffinate phase is

$$28.1 \times 1.235 = 33.7\%$$

The raffinate phase consists, therefore, of 33.7% oil and 16.2% wax, while the extract phase consists of 12.7% asphalt and $43.0 - (33.7 - 28.1) = 37.4\%$ undesirable oil constituents.

The above commercial Duo-Sol yields refer to a 90 viscosity index oil of 25°F. pour point. For a 95 viscosity index oil of 25°F. pour point the Duo-Sol recovery would be

$$33.7 \times [1.00 - 0.02(95 - 90)] = 30.3\%$$

or, $30.3 + 16.2 = 46.5\%$ including wax.

Assume that the plant normally produces a wax cake containing 15% oil. The yield of the dewaxed oil will be, therefore

$$46.5 - 16.2/0.85 = 27.4\%$$

Table 2 gives a comparison between the calculated and observed commercial yields for the four crude oils shown in Table 1.

The important problem in practical application of the laboratory data is the viscosity of the oil. A number of complications arises in its estimate which may be visualized from the following discussions.

Viscosity of the oil from a given crude has a direct relation to its flash point which changes with the distillation equipment employed. However, the latter variable is eliminated by the use of a standardized distillation procedure. A typical crude oil sample will produce solvent extracted products having a certain viscosity-flash point relationship. In laboratory analysis the unknown samples of crude may give a different relationship which may require adjustment in the viscosity of the raw stocks in order to compare the yields of finished products on an equal viscosity basis, if this is desired.

Different viscosities may represent the same viscosity index while the same viscosity may correspond to different viscosity indices depending on the relative quantities of solvent used and the severity of treating conditions. However, within the normal refinery range deviations from the average curves are not excessive for each individual crude oil. Similar considerations apply to viscosity index-yield relationships.

The crude oil assays based on the above outlined principles can be performed in a very short time without requiring expensive or complicated equipment. They are capable of serving as a very reliable tool for estimating quality and yield of the lubricating oil fractions and thus contribute to an overall savings in expenditures by eliminating a considerable reduction in the volume of pilot plant work now required for obtaining a comparable volume of practical information.

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TABLE 2—Calculated and Observed Commercial Lubricating Oil Yields for Various Residua

Crude residuum	A		B		C		D	
	Calcd.	Obs.	Calcd.	Obs.	Calcd.	Obs.	Calcd.	Obs.
Duo-Sol	47	49	65	65	70	70	74	74
Dewaxing	59	60	86	85	86	84	78	75
Overall	28	29	56	55	60	59	56	55

SMALL-SCALE CATALYTIC CRACKING

New Design of Integral T.C.C. Unit Said to Compare in Per Barrel Investment and Operating Cost with Installations in Large Refineries

By H. D. Noll and V. O. Bowles

A brief description is presented of a new design for an integral T.C.C. unit for installation in small refineries. Also included is a series of process and economic studies of typical basic cases showing the application of catalytic cracking with other standard processing operations in the manufacture of motor gasoline, for a refinery processing 10,000 barrels of crude daily.

THE petroleum refining industry is approaching an era which is in many respects unique in its history. Normally the adoption of new processes and new refinery technique must be justified strictly from the standpoint of economics and with consideration of the quality of products dictated by competitive marketing conditions.

The war years, however, witnessed the installation of over 1,000,000 b/d of potential catalytic cracking capacity under conditions where the consideration of economics was secondary to the primary purpose, which was rapid installation of plants for aviation gasoline production with the minimum expenditure of critical materials.

Extensive research and development over many years was intensified during the war, prompted by the necessity for producing the maximum of aviation gasoline. This resulted in a greatly accelerated rate for commercial scale adoption of catalytic cracking developments. Refining technique in catalytic processing was advanced in a period of a little less than four years to an extent which would in all probability have required 15 to 20 years of research and development in normal times.

The developments which have been forthcoming and the improved quality of motor fuels thus made possible have stimulated automotive engineers to develop engine designs which will pass on to the public the advantages in performance which are made possible by reason of the higher quality gasolines which will be available.

The catalytic cracking capacity already installed in this country is equivalent to 23% of the nation's refining capacity and, generally speaking, is capable of producing a volume of super quality motor fuel equivalent to 26% of the nation's normal peace-time demand for all motor fuels. These estimates, however, are based upon national averages and it should be recognized that the catalytic cracking capacity required by wartime demand has been installed in 52 refineries processing about 2,700,000 b/d of crude and representing 58% of the nation's refining capacity. This group of refiners has slightly over 40% of catalytic cracking capacity based upon their crude runs, whereas refiners representing 42% of the nation's crude capacity possess no catalytic cracking whatsoever.

In the face of this situation, the outlook for the potential postwar markets indicates a motor gasoline situation which may well be more competitive than at any time in the history of the industry. Thus, those refiners equipped with adequate catalytic capacity will be able to take advantage of the improved quality motor fuel they are in a position to manufacture in order to expand further the sales of motor fuel in their marketing areas.

The problem of motor fuel quality is even more vital to the operators of small refineries who in years past have depended largely upon the gasoline market to insure continued profits. It is necessary to their sound economic position and to the strength of the petroleum industry as a whole that the operators of small refineries be able to meet the challenge of competitors by producing motor fuel of at least equal quality and at a cost which will enable them to maintain a satisfactory margin of profit.

Houdry Process Corp. engineers for some time have been at work on the development of a small integral Thermofor Catalytic Cracking unit. The goal was to develop a unit which could process 2000 to 3000 b/d of charging stock catalytically with a per barrel investment and operating cost comparable to that for larger plants. The design for these small plants has been completed and the small integral T.C.C. unit is available to the industry.

While these units embody a number of design simplifications, they are nevertheless in principle very similar to the large T. C. C. units built for the war program.

The simplifications include integral elevator design for both spent and regenerated catalyst. Further, it has been possible to eliminate vapor superheaters through increase in catalyst rates. In addition, since the small units are of more compact design, it has been possible to reduce the over-all height and simplify the structure substantially.

Simplifications in this design result

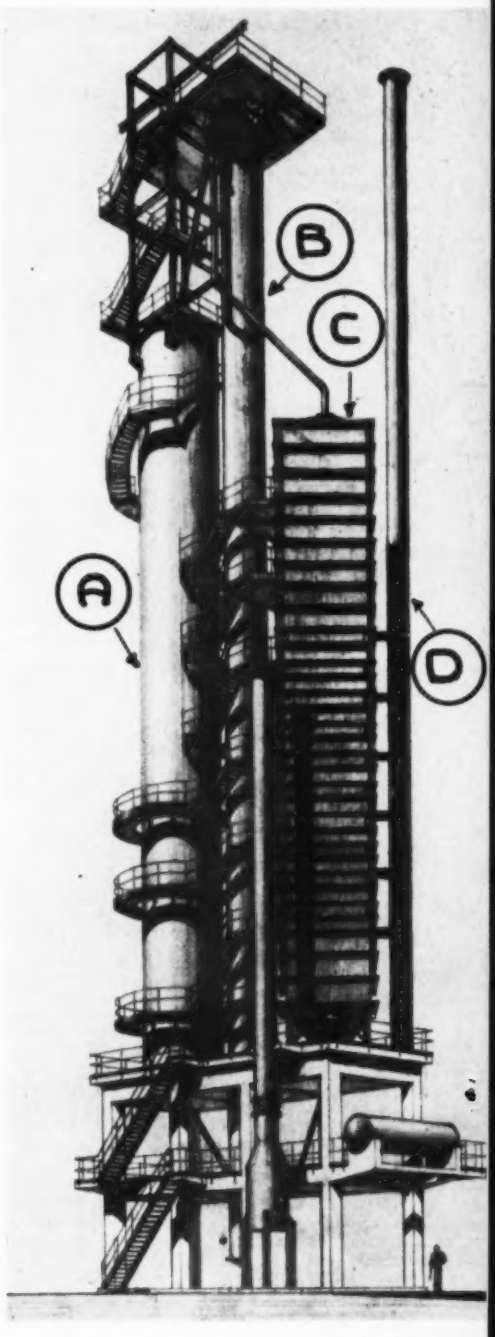

Fig. 1—Isometric sketch of the newly designed T. C. C. unit which has a charge capacity of 2000 to 3000 b/d. The reactor and catalyst hopper are both enclosed in the single column "A", at the left. Spent and regenerated catalyst elevators are likewise enclosed in a single column, "B". The regenerating kiln, "C", and the stack "D" for exhausting flue gases are at the right

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in savings in both operating and maintenance cost, and make it possible for refiners with small staffs to service units with their normal maintenance crews. The T.C.C. kiln and reactor section of the small unit require a space of about 40 ft. x 30 ft., making conversion of existing thermal crackers into catalytic units a very practical consideration. Fig. 1 shows an isometric sketch of the reactor-kiln section of this type of T.C.C. unit.

Heretofore, most methods of refinery octane improvement have depended upon a sacrifice in gasoline output in order to improve quality. Catalytic cracking stands alone as a major refining tool with which high quality motor fuel may be obtained without sacrifice in ultimate output. In fact, catalytic cracking increases the over-all yield of gasoline from a barrel of crude and reduces the yield of residual fuel oil. In this sense, it can be said that catalytic cracking in effect converts refinery residual fuel oil into motor gasoline and at the same time improves the octane number of motors fuel by a substantial margin.

The value of catalytic cracking to a refiner will, of course, depend upon a number of considerations. Perhaps the most vital of these are:

1. The relation of refinery gasoline price to residual fuel price.
2. The octane level required of house-brand and premium fuels.

While only a through analysis of his individual situation will give the refiner his final answer, a general study will usually indicate trends.

With this in mind, an attempt has been made to present herewith a general study of the economics of catalytic cracking for a refiner processing 10,000 b/d of crude oil. There is included within this paper a detailed analysis of all the cases studied together with the basic assumptions employed to permit application of the general conclusions of this study to a particular problem. The following basic cases have been considered:

1. Two-coil thermal cracking with varying depth of reforming and catalytic polymerization.
2. Visbreaking, once-through catalytic cracking, thermal cracking of the T.C.C. cycle stock, and catalytic polymerization, including varying depths of reforming.
3. Visbreaking, recycle catalytic cracking, thermal cracking of the cycle stock and catalytic polymerization. Reforming was not employed.
4. Visbreaking, recycle catalytic cracking, and catalytic polymerization. Thermal cracking was not required as the light catalytic cycle stock was used as No. 2 fuel oil and the heavy catalytic cycle stock in No. 6 fuel blends.

These four cases have been based upon the assumption that 1500 barrels per calendar day of kerosene and 1100 b/d of diesel fuel would be marketed as virgin stocks from the crude. A parallel series of cases (5 to 8) has been developed on the basis of cracking the virgin diesel fuel.

In addition, two cases (9 and 10) have been developed on the basis of producing asphalt for sales in order to ascertain the economic aspects of catalytic versus

TABLE 1—Summary of Yearly Earnings, Retirement Period and Earnings End of 10 Years After Investment Retirement

Case No.	1	2 (c)	3	4	9	10
Octane number	76	76	76	76		
Type of process* (1c)	D, Th, VB	D, VB, TCC, Th.	D, VB, RTCC, Th.	D, VB, RTCC		
Investment, $	1,400,000	2,755,000	2,905,000	2,510,000		
Earnings per year, $	1,239,000	1,547,000	1,641,000	1,632,000		
Payout, yrs.	1.13	1.78	1.77	1.54		
Earnings end 10 yrs., $	10,990,000	12,715,000	13,505,000	13,810,000		
cc's TEL per gal.	2.10	0.85	0.75	0.75		
Octane number	78	78	78	78		
Type of process* (1B)	D, LR, Th. VB	D, VB, TCC, Th.	D, VB, RTCC, Th.	D, VB, RTCC		
Investment, $	1,550,000	2,755,000	2,905,000	2,510,000		
Earnings per year, $	1,164,000	1,475,000	1,567,000	1,564,000		
Payout, yrs.	1.33	1.87	1.85	1.60		
Earnings end 10 yrs., $	10,090,000	11,995,000	12,765,000	13,130,000		
cc's TEL per gal.	1.60	1.30	1.20	1.20		
Octane number	80	80	80	80	80	80
Type of process* (1A)	D, HR, Th, VB	D, VB, TCC, Th.	D, VB, RTCC, Th.	D, VB, RTCC	D, A, HR, Th.	D, A, TCC, Th.
Investment, $	1,640,000	2,755,000	2,905,000	2,510,000	1,745,000	2,945,000
Earnings per year, $	1,015,000	1,380,000	1,469,000	1,480,000	993,000	1,424,000
Payout, yrs.	1.62	2.00	1.98	1.70	1.76	2.07
Earnings, end 10 yrs., $	8,510,000	11,045,000	11,785,000	12,290,000	8,185,000	11,295,000
cc's TEL per gal.	2.00	1.90	1.80	1.75	2.00	2.00
Octane number	82	82	82	82	82	82
Type of process* (1A)	D, HR, Th. VB	D, VB, TCC, Th.	D, VB, RTCC, Th.	D, VB, RTCC	D, A, HR, Th.	D, A, TCC, Th.
Investment, $	1,640,000	2,755,000	2,905,000	2,510,000	1,745,000	2,945,000
Earnings per year, $	898,000	1,246,000	1,338,000	1,365,000	857,000	1,282,000
Payout, yrs.	1.83	2.21	2.17	1.84	2.04	2.30
Earnings end 10 yrs., $	7,340,000	9,705,000	10,475,000	11,140,000	6,825,000	9,875,000
cc's TEL per gal.	2.90	2.75	2.60	2.50	3.05	2.90

*CODE
D—Diesel Fuel to Sales
HR—Reforming 1600 b/cd
LR—Reforming 1050 b/cd
TCC—Once Through TCC Cracking
RTCC—1:1 Recycle TCC Cracking
Th—Thermal Cracking Virgin or TCC Gas Oils
VB—Vis Breaking Tar Separator Bottoms or other reduced crude
A—Asphalt to Sales
(1A) (1B) (1C) refer to subcase under Case 1.

TABLE 2—Summary of Economics of Cases 9 and 10 in Table 1
(Diesel Fuel to Sales)

Case No:		9		10	
Revenue	c/Gal.	b/cd	$/Day	b/cd	$/Day
10 lb. RVP Motor Gasoline	6.250°	4,710	12,364	5,708	14,984
Kerosine	4.250	1,500	2,678	1,500	2,678
Diesel Fuel	3.625	1,100	1,675	1,100	1,675
Residual Fuel	2.145	1,429	1,286	755	680
Asphalt	3.750	600	945	600	945
Dry Gas (F.O.E.)	2.145	670	603	445	400
Excess Butane	1.450	36	22	.....	.....
Total Revenue			19,303		21,362
Operating Costs					
Crude		10,000	14,000	10,000	14,000
Crude Distillation		10,000	420	10,000	420
Vacuum Reduction		3,000	150	1,500	118
T.C.C. Cracking		.....	.....	3,900	565
T.C.C. Gas Plant		.....	.....	.....	217
Thermal Cracking†		5,500	675	1,799	355
Debutanization‡		.....	18	.....	34
Catalytic Poly.		188	159	244	181
Gasoline Inhibitor		4,710	5	5,708	6
Taxes, Int., Ins.		.....	239	.....	403
T.C.C. Royalty		.....	.....	.....	195
Thermal Royalty		.....	165	.....	54
Cat. Poly. Royalty		188	39	244	51
TEL to 76 CFRM (M cc's)		158	284	216	389
Total Operating Costs			16,154		16,988
Earnings, $/Day			3,149		4,374
TEL to 78 CFRM (M cc's)		267	481	324	583
Earnings, $/Day			2,952		4,180
TEL to 80 CFRM (M cc's)		396	713	479	862
Earnings, $/Day			2,720		3,901
TEL to 82 CFRM (M cc's)		603	1,085	695	1,251
Earnings, $/Day			2,348		3,512
Investments (Process Equipment Only)					
Crude Distillation			$ 350,000		$ 350,000
Vacuum Reduction			330,000		240,000
T.C.C. Catalytic Section			.....		1,175,000
T.C.C. Fractionation Section			.....		.....
T.C.C. Gas Plant			.....		490,000
Thermal Cracking and Gas Plant			855,000		440,000
Catalytic Polymerization			210,000		250,000
Total			$1,745,000		$2,945,000

° Based on 75% housebrand and 25% premium fuel.
† Total for thermal cracking and gas plant.
‡ Utilities only.

thermal cracking for this type of operation.

The price structure and utility values assumed are presented in the following table:

Stock	Price $
Mid-Continent crude, bbl	1.40
Housebrand motor gasoline, gal	0.0625
Kerosene, gal	0.0425
Diesel fuel, gal	0.03625
No. 2 fuel, gal	0.03625
No. 6 fuel, bbl.	0.90
Butanes, gal	0.0145
Fuel Gas, MM Btu	0.15
Steam, M lbs.	0.24
Power, KWH	0.007
Water (Cooling) M gal	0.005
Water (Treated) M gal	0.15
Clay Catalyst, lb.	0.04

The above prices are, of necessity, arbitrarily chosen. For an individual refiner to obtain a true picture, it is recommended that he substitute his own price structure.

The maintenance on topping units and gas plant was set at 3% of the investment, whereas for catalytic cracking, thermal cracking and catalytic polymerization a rate of 4% was established. The taxes, interest and insurance were set at 5.0% of the investment. Estimated royalty rates were used for catalytic and thermal cracking and catalytic polymerization processes and are shown in the detailed tables.

A summary of economics, showing yearly earnings, retirement periods, and earnings at the end of 10 years during which period the investment has been retired, is presented in Table 1. Cases 1, 2, 3, 4, 9 and 10, all involving the production of diesel fuel for sales, have been considered in this series of cases for economic comparisons. While a series of cases parallel to 1, 2, 3, and 4, shown in Table 1, has been developed on the basis of cracking the diesel fuel, these cases have not been summarized as in Table 1 since the same general conclusions are reached.

Complete details showing the development of the economics for all of these cases are presented in Tables 2, 3 and 4. In cases 1 and 2 (also cases 5 and 6) shown in Tables 3 and 4, involving all thermal cracking and once-through catalytic cracking, respectively, the effect is shown of varying the depth of reforming from zero, as indicated in Case 1C, to a maximum of 1600 b/d, as indicated in Case 1A, with Case 1B as an intermediate.

For each case studied, a depth of reforming was selected for comparison which resulted in maximum dollar return, provided a lead limit of 2 cc per gallon was not exceeded. This limit was imposed because of the generally poor road performance shown with highly leaded fuels; and because of the desirability from the standpoint of flexibility in refining operations of reaching a given motor fuel octane number with a minimum of TEL.

Over-all commodity balances, capacities of the various processing units, and clear octane numbers with lead requirements for various octane levels of the motor gasoline are shown in Tables 5, 6 and 7. The gasoline price of 6.25c gal. was arrived at on the basis of 75% of housebrand gasoline at 6c and 25% of premium fuel at 7c gal. At the 80-

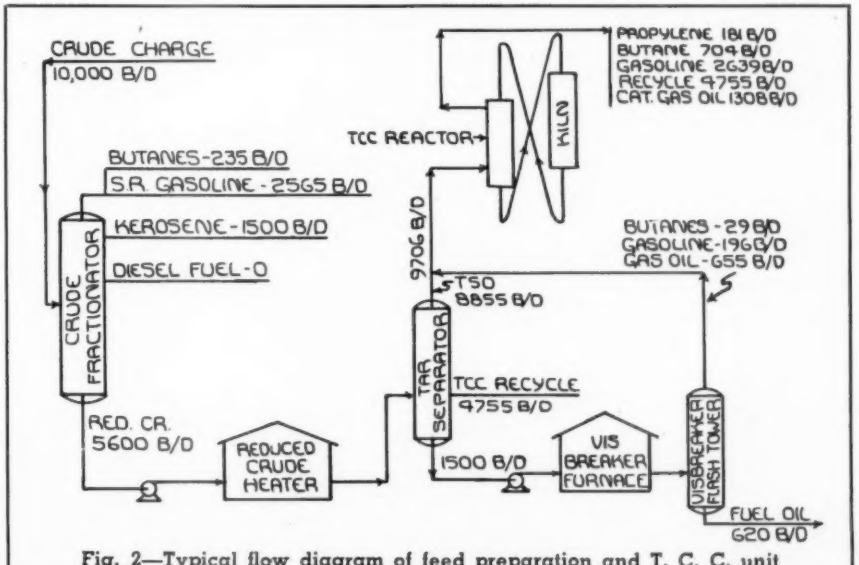

Fig. 2—Typical flow diagram of feed preparation and T. C. C. unit

TABLE 3—Summary of Economics of Cases 1, 2, 3 and 4 in Table 1
(Diesel Fuel to Sales)

Case No.		1A		1B		1C		2A		2B		2C		3		4	
Revenue	c/Gal.	b/cd	$/Day	b/cd	$/Day	b/cd	$/Day	b/cd	$/Day	b/cd	$/Day	b/cd	$/Day	b/cd	$/Day	b/cd	$/Day
10 lb. R.V.P. Motor Gasoline	6.250*	4,740	12,443	4,843	12,713	4,975	13,059	5,346	14,033	5,491	14,414	5,722	15,020	5,941	15,595	5,516	14,480
Kerosine	4.250	1,500	2,678	1,500	2,678	1,500	2,678	1,500	2,678	1,500	2,678	1,500	2,678	1,500	2,678	1,500	2,678
Diesel Fuel	3.625	1,100	1,675	1,100	1,675	1,100	1,675	1,100	1,675	1,100	1,675	1,100	1,675	1,100	1,675	1,100	1,675
No. 2 Fuel	3.625	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	658	1,002
Residual Fuel	2.145	2,067	1,860	2,045	1,841	2,003	1,803	1,391	1,252	1,369	1,232	1,327	1,194	1,078	970	949	854
Dry Gas (F.O.E.)	2.145	698	628	636	572	522	470	685	617	623	561	509	458	478	430	329	296
Excess Butane	1.450	20	12	.....	.....	.....	.....	132	81	74	45	.....	.....	70	43	74	45
Total Revenue			19,296		19,479		19,685		20,336		20,605		21,025		21,391		21,030
Operating Costs																	
Crude	3.33	10,000	14,000	10,000	14,000	10,000	14,000	10,000	14,000	10,000	14,000	10,000	14,000	10,000	14,000	10,000	14,000
Crude Distillation		10,000	420	10,000	420	10,000	420	10,000	420	10,000	420	10,000	420	10,000	420	10,000	420
T.C.C. Cracking		.....	.....	.....	.....	.....	.....	3,650	540	3,650	540	3,650	540	7,310§	710	7,310§	710
T.C.C. Gas Plant									212		212		212		223		223
Thermal Cracking†		6,100	751	5,540	706	4,500	585	4,782	586	4,222	539	3,182	378	2,487	314	1,500	107
Debutanization‡			18		16		11		34		31		26		34		30
Catalytic Poly.		180	157	153	147	106	130	310	204	287	196	239	179	259	186	229	175
Gasoline Inhibitor		4,740	5	4,843	5	4,975	5	5,346	5	5,491	5	5,722	6	5,941	6	5,516	6
Taxes, Int., Ins.			225		212		192		410		397		377		398		344
T.C.C. Royalty		.....	.....	.....	.....	.....	.....	3,650	183	3,650	183	3,650	183	3,655	183	3,655	183
Thermal Royalty		6,100	183	5,540	166	4,500	135	3,282	98	2,722	82	1,682	50	987	30	.....	.....
Cat. Poly. Royalty		180	38	153	32	106	22	310	65	287	60	239	50	259	54	229	48
TEL to 76 CFRM (M cc's)		149	269	223	402	439	790	29	53	69	125	204	367	187	337	174	313
Total Operating Costs			16,066		16,106		16,290		16,810		16,790		16,788		16,895		16,559
Earning $/Day			3,230		3,373		3,395		3,526		3,815		4,237		4,496		4,471
TEL to 78 CFRM (M cc's)		239	430	325	586	606	1,091	79	141	150	270	312	562	299	539	278	500
Earnings $/Day			3,069		3,189		3,094		3,438		3,670		4,042		4,294		4,284
TEL to 80 CFRM (M cc's)		398	717	488	879	794	1,429	164	295	265	477	457	823	449	808	405	730
Earnings $/Day			2,782		2,896		2,756		3,284		3,463		3,781		4,025		4,054
TEL to 82 CFRM (M cc's)		577	1,039	712	1,281	1,107	1,993	292	525	415	747	661	1,190	649	1,168	598	1,043
Earnings $/Day			2,460		2,494		2,192		3,054		3,193		3,414		3,665		3,741
Investments (Process Equipment Only)																	
Crude Distillation			$ 350,000		$ 350,000		$ 350,000		$ 350,000		$ 350,000		$ 350,000		$ 350,000		$ 350,000
T.C.C. Catalytic Section			.....		.....		.....		650,000		650,000		650,000		725,000		725,000
T.C.C. Fractionation Section			.....		.....		.....		475,000		475,000		475,000		575,000		575,000
T.C.C. Gas Plant			.....		.....		.....		470,000		470,000		470,000		520,000		520,000
Thermal Cracking and Gas Plant			1,080,000		1,010,000		890,000		760,000		685,000		565,000		480,000		100,000
Catalytic Polymerization			210,000		190,000		160,000		285,000		270,000		245,000		255,000		240,000
Total			$1,640,000		$1,550,000		$1,400,000		$2,990,000		$2,900,000		$2,755,000		$2,905,000		$2,510,000

* Based on 75% Housebrand + 25% Premium Fuel. § Total Feed—1:1 Recycle. † Total for Thermal Cracking and Gas Plant. ‡ Utilities only.

TABLE 4—Summary of Economics of Cases Parallel to Cases 1, 2, 3 and 4
(Diesel Fuel to Cracking)

Case No.		5A		5B		5C		6A		6B		6C		7		8	
Revenue	c/Gal.	b/cd	$/Day	b/cd	$/Day	b/cd	$/Day	b/cd	$/Day	b/cd	$/Day	b/cd	$/Day	b/cd	$/Day	b/cd	$/Day
10 lb. R.V.P. Motor Gasoline	6.250*	5,529	14,514	5,638	14,800	5,804	15,236	6,168	16,191	6,309	16,561	6,541	17,170	6,796	17,840	6,239	16,377
Kerosine	4.250	1,500	2,678	1,500	2,678	1,500	2,678	1,500	2,678	1,500	2,678	1,500	2,678	1,500	2,678	1,500	2,678
No. 2 Fuel	3.625	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	979	1,491
Residual Fuel	2.145	2,264	2,038	2,242	2,018	2,200	1,980	1,611	1,450	1,589	1,430	1,547	1,392	1,228	1,105	949	854
Dry Gas (F.O.E.)	2.145	888	799	825	743	711	640	826	743	764	688	650	585	552	497	375	338
Excess Butane	1.450	21	13	.....	.....	.....	.....	115	70	70	43	.....	.....	100	61	94	57
Total Revenue			20,042		20,239		20,534		21,132		21,400		21,825		22,181		21,795

TABLE 4—(cont'd.)

Case No.		5A		5B		5C		6A		6B		6C		7		8	
Revenue	c/Gal.	b/cd	$/Day	b/cd	$/Day	b/cd	$/Day	b/cd	$/Day	b/cd	$/Day	b/cd	$/Day	b/cd	$/Day	b/cd	$/Day
Operating Costs																	
Crude	3.33	10,000	14,000	10,000	14,000	10,000	14,000	10,000	14,000	10,000	14,000	10,000	14,000	10,000	14,000	10,000	14,000
Crude Distillation		10,000	420	10,000	420	10,000	420	10,000	420	10,000	420	10,000	420	10,000	420	10,000	420
T.C.C. Cracking		.....	.....	.....	.....	.....	.....	3,650	540	3,650	540	3,650	540	7,310§	710	7,310§	710
T.C.C. Gas Plant									212		212		212		223		223
Thermal Cracking†		6,100	751	5,540	706	4,500	585	4,782	586	4,222	539	3,182	378	2,487	314	1,500	107
Debutanization‡			18		16		11		34		31		26		34		30
Catalytic Poly.		180	157	153	147	106	130	310	204	287	196	239	179	259	186	229	175
Gasoline Inhibitor		4,740	5	4,843	5	4,975	5	5,346	5	5,491	5	5,722	6	5,941	6	5,516	6
Taxes, Int., Ins.			225		212		192		410		397		377		398		344
T.C.C. Royalty		.....	.....	.....	.....	.....	.....	3,650	183	3,650	183	3,650	183	3,655	183	3,655	183
Thermal Royalty		6,100	183	5,540	166	4,500	135	3,282	98	2,722	82	1,682	50	987	30	.....	.....
Cat. Poly. Royalty		180	38	153	32	106	22	310	65	287	60	239	50	259	54	229	48
TEL to 76 CFRM (M cc's)		149	269	223	402	439	790	29	53	69	125	204	367	187	337	174	313
Total Operating Costs			16,066		16,106		16,290		16,810		16,790		16,788		16,895		16,559
Earning $/Day			3,976		4,133		4,244		4,322		4,610		5,037		5,286		5,236
TEL to 78 CFRM (M cc's)		239	430	325	586	606	1,091	79	141	150	270	312	562	299	539	278	500
Earnings $/Day			3,815		3,953		3,943		4,234		4,510		4,837		5,086		5,036
TEL to 80 CFRM (M cc's)		398	717	488	879	794	1,429	164	295	265	477	457	823	449	808	405	730
Earnings $/Day			3,528		3,660		3,605		4,088		4,317		4,637		4,886		4,830
TEL to 82 CFRM (M cc's)		577	1,039	712	1,281	1,107	1,993	292	525	415	747	661	1,190	649	1,168	598	1,043
Earnings $/Day			3,219		3,367		3,267		3,942		4,187		4,437		4,686		4,623
Investments (Process Equipment Only)																	
Crude Distillation			$ 350,000		$ 350,000		$ 350,000		$ 350,000		$ 350,000		$ 350,000		$ 350,000		$ 350,000
T.C.C. Catalytic Section			.....		.....		.....		650,000		650,000		650,000		725,000		725,000
T.C.C. Fractionation Section			.....		.....		.....		475,000		475,000		475,000		575,000		575,000
T.C.C. Gas Plant			.....		.....		.....		470,000		470,000		470,000		520,000		520,000
Thermal Cracking and Gas Plant			1,080,000		1,010,000		890,000		760,000		685,000		565,000		480,000		100,000
Catalytic Polymerization			210,000		190,000		160,000		285,000		270,000		245,000		255,000		240,000
Total			$1,640,000		$1,550,000		$1,400,000		$2,990,000		$2,900,000		$2,755,000		$2,905,000		$2,510,000

TABLE 4—(cont'd.)

Case No.		5A		5B		5C		6A		6B		6C		7		8	
Revenue	¢/Gal.	b/cd	$/Day	b/cd	$/Day	b/cd	$/Day	b/cd	$/Day	b/cd	$/Day	b/cd	$/Day	b/cd	$/Day	b/cd	$/Day
Operating Costs																	
Crude	3.33	10,000	14,000	10,000	14,000	10,000	14,000	10,000	14,000	10,000	14,000	10,000	14,000	10,000	14,000	10,000	14,000
Crude Distillation		10,000	420	10,000	420	10,000	420	10,000	420	10,000	420	10,000	420	10,000	420	10,000	420
T.C.C. Cracking								4,755	627	4,755	627	4,755	627	9,510§	868	9,510§	868
T.C.C. Gas Plant											235		235		247		247
Thermal Cracking†		7,200	859	6,640	813	5,600	693	8,307	631	4,747	587	3,707	428	2,808	344	1,500	107
Debutanization†			23		21		17		41		39		35		43		39
Catalytic Poly.		229	175	204	166	69	115	378	228	362	222	313	185	331	211	290	197
Gasoline Inhibitor		5,529	6	5,638	6	5,804	6	6,168	6	6,309	6	6,541	7	6,796	7	6,239	6
Taxes, Int., Ins.			252		240		210		450		441		422		465		405
T.C.C. Royalty								4,755	238	4,755	238	4,755	238	4,755	238	4,755	238
Thermal Royalty		7,200	216	6,640	199	5,600	168	3,807	114	3,247	97	2,207	66	1,308	39		
Cat. Poly. Royalty		229	48	204	43	69	15	378	80	362	76	313	66	331	70	290	61
TEL to 76 CFRM (M cc's)		197	355	225	405	475	856	39	70	53	95	206	371	171	308	157	283
Total Operating Costs			16,354		16,313		16,500		17,140		17,083		17,100		17,260		16,871
Earnings $/Day			3,688		3,926		4,034		3,992		4,317		4,725		4,921		4,924
TEL to 78 CFRM (M cc's)		313	564	355	639	658	1,185	104	186	132	239	330	594	294	529	267	481
Earnings $/Day			3,479		3,692		3,705		3,876		4,173		4,502		4,700		4,726
TEL to 80 CFRM (M cc's)		488	878	533	959	878	1,580	207	373	252	453	495	890	457	822	406	731
Earnings $/Day			3,165		3,372		3,310		3,689		3,959		4,206		4,407		4,476
TEL to 82 CFRM (M cc's)		720	1,296	781	1,407	1,219	2,194	389	699	424	763	742	1,335	671	1,207	590	1,061
Earning $/Day			2,747		2,924		2,696		3,363		3,649		3,761		4,022		4,146
Investments (Process Equipment Only)																	
Crude Distillation			$ 350,000		$ 350,000		$ 350,000		$ 350,000		$ 350,000		$ 350,000		$ 350,000		$ 350,000
T.C.C. Catalytic Section									725,000		725,000		725,000		900,000		900,000
T.C.C. Fractionation Section									575,000		575,000		575,000		700,000		700,000
T.C.C. Gas Plant Section									520,000		520,000		520,000		630,000		630,000
Thermal Cracking + Gas Plant			1,250,000		1,175,000		1,060,000		800,000		740,000		625,000		520,000		100,000
Catalytic Polymerization			240,000		225,000		125,000		320,000		310,000		285,000		295,000		275,000
Total			$1,840,000		$1,750,000		$1,535,000		$3,290,000		$3,220,000		$3,080,000		$3,395,000		$2,955,000

* Based on 75% Housebrand + 25% Premium Fuel. § Total Feed—1:1 Recycle. † Total for Thermal Cracking and Gas Plant. ‡ Utilities Only.

octane level, this would mean that house-brand fuel would have a 78 and the premium fuel an 85-octane number.

The basic yields used for the various processes are shown in Tables 8, 9 and 10.

In every case except where asphalt is produced, it has been assumed that the reduced crude would be visbroken in order to minimize residual fuel. In these cases with catalytic cracking, the total vaporizable effluent from the viscosity breaking operation flows directly to the catalytic cracking unit as is illustrated in the typical flow diagram, Fig. 2. There are, of course, other processing methods (such as propane deasphalting or vacuum flashing) which can be employed in order to charge a heavier stock to the catalytic plant.

While the flexibility of T.C.C. units is such that these heavy charging stocks can be readily handled, the aforementioned methods of processing (vacuum flashing and propane deasphalting) were not considered in the economic studies presented herein except in those cases involving the manufacture of asphalt since it is believed that expensive means of charge stock preparation cannot be justified unless outlets for specialty products such as asphalt are available. The gasoline yield advantage generally obtained through processing reduced crude to pitch by distillation or deasphalting is virtually eliminated if it becomes necessary to blend the pitch back to marketable fuel oil.

A series of charts has been prepared to

(*Continued on page* R-841)

TABLE 5—Summary of Yields and Process Equipment
(Diesel and Asphalt to Sales)

Type Operation	Thermal Cracking and Reforming	Catalytic Cracking, Thermal Cracking T.C.C. Cycle
Case Nos.	9	10
Products, b/cd		
10 lb. RVP Gasoline	4,710	5,708
Kerosene	1,500	1,500
Diesel Fuel	1,100	1,100
Residual Fuel	1,429	755
Asphalt	600	600
Excess Butane	36	...
Dry Gas (F.O.E.)	670	445
Crude Run	10,000	10,000
Process Equipment, b/sd		
Crude Distillation	11,100	11,100
Vacuum Reduction	3,330	1,665
Thermal Cracking Gas Oil	4,330	2,000
Thermal Cracking Reduced Crude	...	...
Thermal Reforming	1,775	...
T.C.C.	...	4,330
Catalytic Polymerization	210	271
Octane Nos.		
CFRM + 0 cc TEL	69.9	68.6
TEL to 76 CFRM	0.80	0.90
TEL to 78 CFRM	1.35	1.35
TEL to 80 CFRM	2.00	2.00
TEL to 82 CFRM	3.05	2.90

ONE HUNDRED TWENTY-SIX UOP UNITS were designed, constructed and placed in operation for production of war-time fuels.

Codimer	56	Isomerization	13
HF Alkylation	28	Cumene	11
Catalytic Cracking	13	Dehydrogenation	5

The technique and know-how developed during the war in the research, design, and operation of these units together with that accumulated for many years before the war are now available for the post-war period.

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Slow-Motion Pictures Throw New Light On the Cause of Knock in Fuel Combustion

Camera Developed by N.A.C.A. Engineer Photographs Burning of Fuel in Engine Cylinders at the Rate of 40,000 Frames a Second; Aids Knock Study

SLOW-MOTION pictures have become an important means for the study of knocking and other phenomena of fuel combustion in engine cylinders as a result of a new technique in high-speed photography. Author of the new technique is Cearcy D. Miller, a mechanical engineer in the Aircraft Engine Research Laboratory in Cleveland of the National Advisory Committee for Aeronautics.

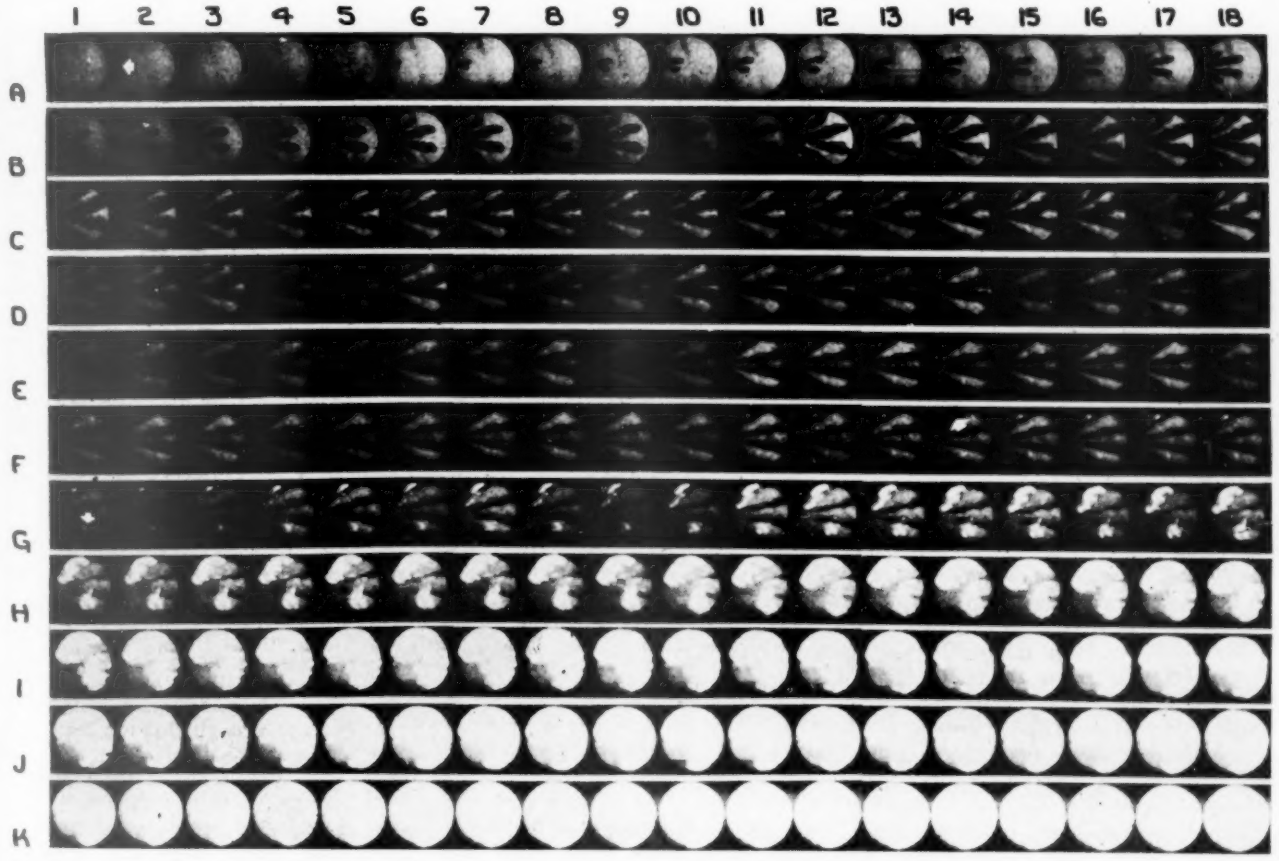
The camera Mr. Miller uses takes photographs at the extreme speed of 40,000 frames a second. For purposes of comparison, high-speed photography of only 10 years ago made possible only 2000 to 4000 frames a second. Ordinary motion pictures, where the speed of motion as seen on the screen is the same as the actual speed of the action portrayed, are taken at the rate of 16 to 24 frames a second.

Pictures Slowed Down 2500 Times

The photographs taken by the new high-speed motion picture camera are reproduced on the screen in slow-motion at a rate 2500 times slower than the actual duration of the combustion reaction. By comparison, a baseball player in action, slowed down to the same relative rate, would take three and a half hours to travel from home plate to first base.

The course of the injection and combustion of fuel in the cylinder of a test engine can be readily followed in the slow-motion pictures. For example, the actual average speed of the injection spray tip in some of the studies was about 210 feet a second. When the photographs are projected on the screen at 16 frames per second, the apparent average speed of the spray tip scaled to the actual combustion-chamber dimensions is approximately one inch per second, a rate easily followed by the eye.

Earlier photographs taken at the rate of about 2500 frames a second were fast enough to reveal the important details of the injection and combustion of fuel, it is said, but only when the individual frames were studied as still pictures. These speeds, however, were not adequate to photograph a certain phenomenon in spark-ignition knock which it was desired to study. This phenomenon is described as being so fast that it can occur in the blind time between the exposures of two successive frames of



This sequence of 198 pictures, showing injection and combustion of fuel in a Diesel engine cylinder, was taken in less than .005 of a second. Fuel injection, which is just beginning to be apparent in frame A-2, began at 3° B.T.C. In the original negatives combustion is first visible in frame F-10, 99 frames after the start of injection. In the pictures as reproduced here, however, because of the loss of detail it isn't apparent until frame F-14. A few frames later a second bright spot indicates that combustion has begun at another point. Peak combustion develops at about frame K-18

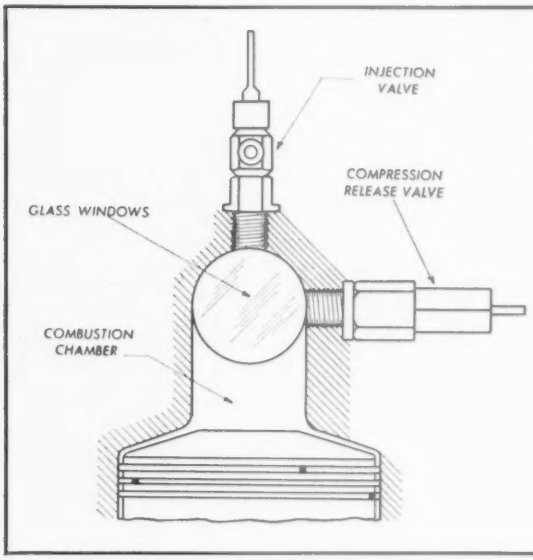


Fig. 1—Front view of cylinder head of the glass-windowed Diesel engine used with the high-speed camera

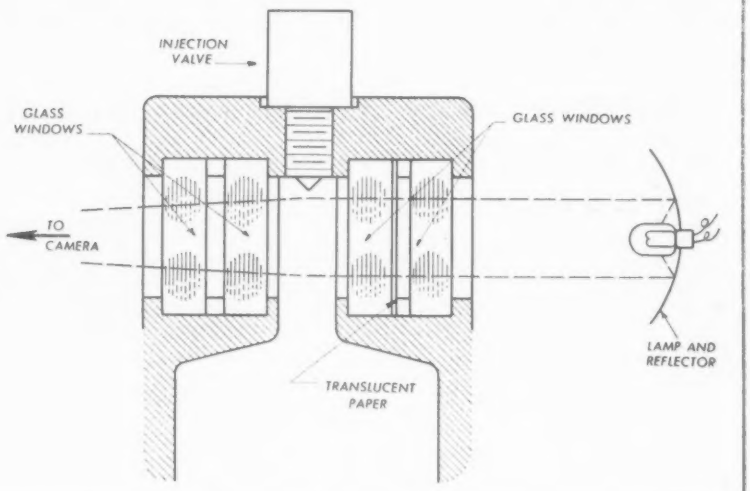


Fig. 2—Side view of the cylinder head showing the glass windows, and sketch of the optical system

pictures taken at the rate of 2000 to 4000 frames a second.

The need for a slow-motion picture of spark-ignition engine knock started Mr. Miller in 1936 to develop a faster camera than was then commercially available. His new camera, operating 16 times as fast, was first successfully tested late in 1938 and has since been almost exclusively used in the study of spark-ignition engine knock in the wartime projects at N.A.C.A.

Studies of Combustion

Brief studies were made of fuel injection and combustion in a Diesel engine in intervals between the spark-ignition projects. Neither the data on the spark-ignition projects nor details of construction of the camera have yet been made public. However, some remarks on high speed motion picture cameras fast enough to record the details of fuel combustion in an engine cylinder were given by Mr. Miller in a talk before the Cleveland Section of the Society of Automotive Engineers May 17. At the same time he showed slow-motion pictures of fuel injection and combustion in a Diesel engine cylinder. The pictures on the cover of this issue and with the accompanying article are from a sequence taken with the newly developed camera at the rate of 40,000 frames per second.

The following paragraphs are from introductory remarks by Mr. Miller in his presentation before the Cleveland S.A.E. audience:

"The high-speed motion-picture camera performs the same function relative to time that the microscope accomplishes relative to physical space. Because of its ability to slow down motion, or to magnify time, the high-speed camera is of great value in making a scientific study of movements or events that are too rapid to be seen directly by eye.

"In ordinary motion-picture work, where it is desired that the speed of motion as seen on the screen be the same as the actual speed of the event, the camera must operate at the same speed as the projector, 16 to 24 frames per second. At these comparatively low speeds intermittent mechanisms are used; that is, the film is moved in the camera a distance equal to one frame height, then the film is held stationary while the camera shutter is opened and a frame is exposed, then the film is moved again and held still again while the next picture is taken, and so on. The intermittent mechanism is also used for slow-motion pictures of sports events, which are taken at about four times the projection rate.

"When the speed of camera operation, however, must go much higher than a hundred frames per second it is not physically possible to bring the film to a standstill during the exposure of each frame. Instead it is necessary that the film be kept moving continuously. Now when light is focused to form an image on a moving film there is a problem involved to prevent blurring of the photograph on the film because of the motion of the film during the time of exposure. It is either necessary that the exposure time be made so extremely short that the film does not have time to move appreciably during the exposure, or it is necessary that the image formed by the camera lens be moved right along with the film during the times of exposure.

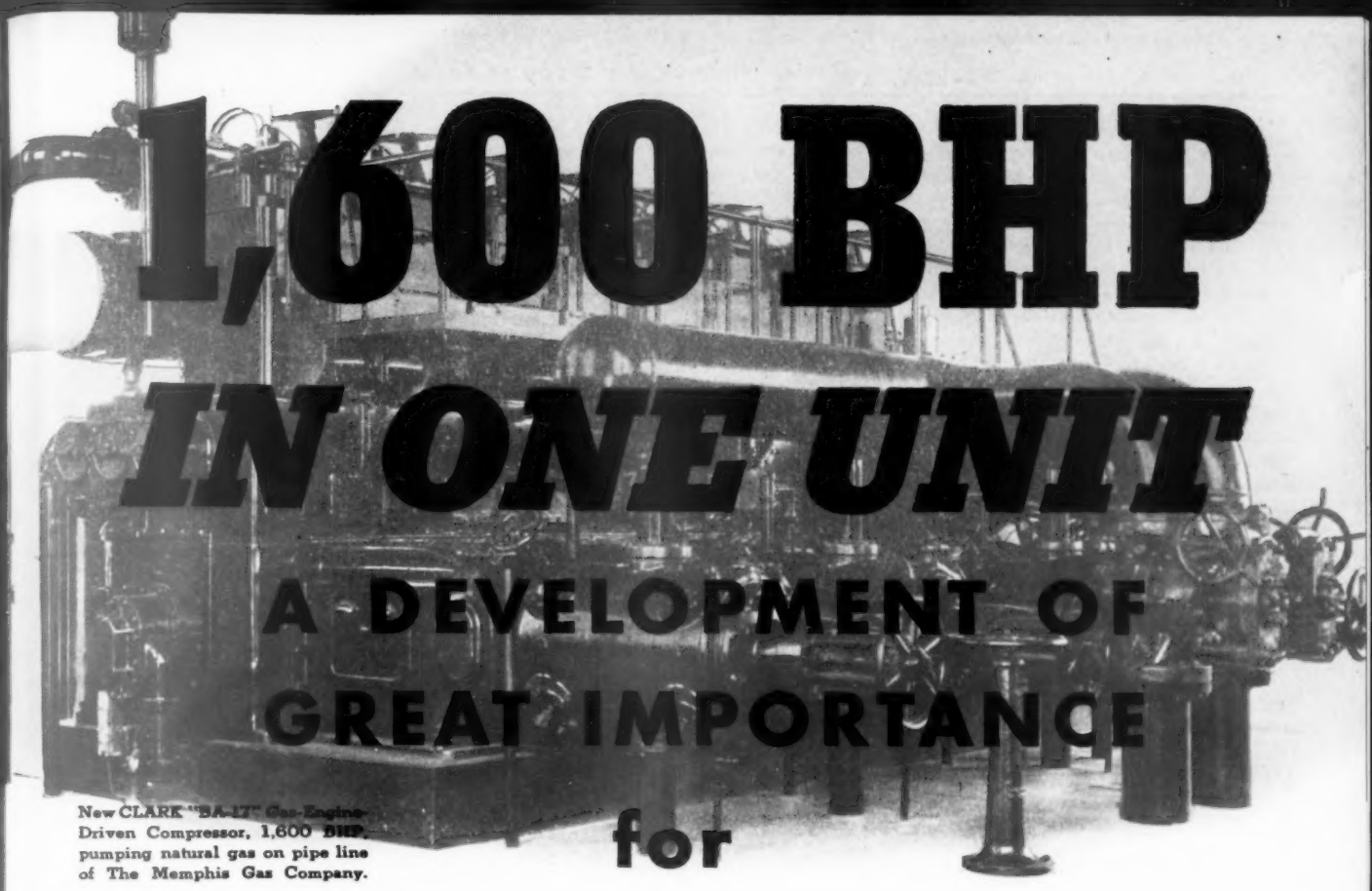
"Extremely short exposure times, to allow negligible film movement during exposure, are accomplished with spark photography. Spark photography, however, has serious disadvantages for many kinds of work and is of course entirely inapplicable in any case where the object you want to photograph is itself a light source. The other method (producing moving images that are stationary relative to the moving film) is more extensively used than spark photography. This method is referred to as 'optical compensation'. The number of optical-compensating mechanisms known and used is surprisingly large. There are about half a dozen distinct types and innumerable subtypes.

2000-4000 Frames a Second Are Common

"During recent years moderate-high-speed photography has come into very widespread use in connection with the commercial development of fast-moving mechanisms such as high-speed looms or the breach mechanisms of automatic rifles. By 'moderate-high-speed photography' I refer to speeds ranging from about 2000 to 4000 frames per second. Some excellent photographic mechanisms and techniques have been developed for these speeds.

"Development of these moderate-high-speed cameras and techniques has gone ahead of the development of the extreme high-speed cameras. The reason is probably not so much a matter of greater difficulty in the case of the higher speeds. Instead it is the fact that there are so very few phenomena that take place quickly enough to require the higher photographic speeds. It is only when an event occurs with the rapidity of an explosion that speeds of the order of 40,000 frames per second or higher are needed to make the details clear.

"Motion pictures of combustion in engine cylinders were taken at moderate high speeds about ten years ago both by the N.A.C.A. and by General Motors.



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The moderate speeds were fast enough to reveal the details of fuel injection and combustion except in the case of spark-ignition engine knock. They were entirely inadequate to photograph a certain phenomenon involved in spark-ignition engine knock. This phenomenon is so fast that it can occur in the blind time between the exposures of two successive frames at two to four thousand frames per second. It was the need for a slow-motion picture of spark-ignition engine knock that caused Mr. Addison M. Rothrock to ask me in 1936 to attempt the development of a faster camera than was then commercially available. The resulting camera operated fast enough, at 40,000 frames per second, to obtain a motion picture of spark-ignition engine knock, but it is by no means a 'slow-motion' picture. Still higher speeds will be required to tell the whole story."

The following description of the engine and fuel injection system used in connection with the new high-speed camera is given in the earlier portion of Mr. Miller's paper, entitled "Slow-Motion Study of Injection and Combustion of Fuel in a Diesel Engine":

Apparatus and Procedure

"Figs. 1 and 2 show two schematic views of the cylinder head. As may be seen from these figures the visible portion of the combustion chamber has the shape of a flat disk. The flat-disk portion of the chamber is interconnected with the interior of the engine cylinder by a vertical passage whose cross-section is a narrow rectangle.

"The cylinder has a 5-in. bore and a 7-in. stroke. The engine is brought up to speed by an electric motor and is fired for only one cycle, during which high-speed motion pictures are taken. Air escapes from the cylinder during each compression stroke of the motoring period through the compression-release valve shown in Fig. 1. Air enters the cylinder through ports 0.5 in. wide, which are uncovered by the piston at the bottom of its stroke.

"This arrangement causes about 72% of the air charge to be replaced at each engine revolution. This replacement has been found necessary in order to avoid excessive reduction of the heat content of the air charge during the motoring period. The engine is maintained at operating temperature by means of heated glycerine circulated through passages in the head and in the walls of the cylinder.

"After the engine has been brought up to speed, an auxiliary shaft is engaged with the engine crankshaft by a single-revolution clutch. This auxiliary shaft, through an assemblage of cams and switches, first provides a surge of oil pressure to the compression-release valve to keep the valve closed throughout the firing cycle, then provides an impulse that opens the camera shutter, and finally releases the single charge of fuel to the injection valve shown at the top of the combustion chamber in Fig. 1. The camera shutter automatically closes after a sufficient time interval to allow injection and combustion of the single charge of fuel.

"The two glass windows on each side of the flat-disk combustion chamber, as shown in Fig. 2, are separated by a spacer. Two windows were provided instead of one on each side of the chamber to provide a measure of safety in case of failure of one of the stressed inner windows.

100-Watt Lamp Silhouettes Image

"A 100-watt incandescent lamp with a reflector is placed at the side of the head opposite the camera as shown in Fig. 2. The light from this lamp is projected onto a translucent paper disk placed between the inner glass window and the window spacer. The diffused light passing through the translucent paper disk goes through the combustion chamber and through the two glass windows on the other side of the chamber to the camera.

"This light is sufficient to allow the camera to photograph the paper disk at 40,000 frames per second. The fuel sprays are consequently photographed as silhouettes against the translucent paper background. The burning of the fuel, which begins after the injection is well under way, is so luminous that it eclipses the much fainter luminosity of the translucent paper disk; thus both the fuel spray and the combustion are photographed under the same conditions."

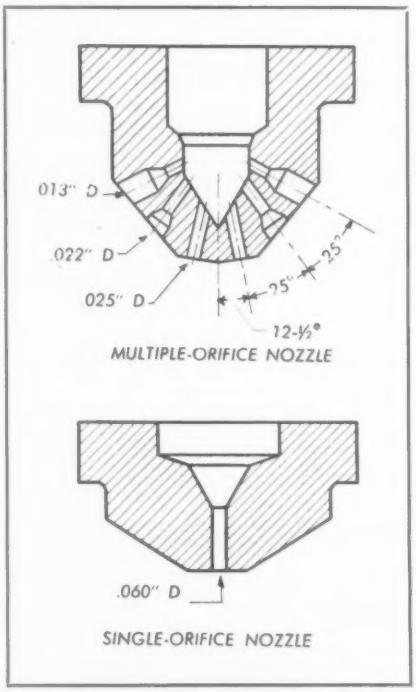

Fig. 3—Two common types of injection nozzles used with the test Diesel engine: upper, multiple-orifice nozzle; lower, single-orifice nozzle

The following engine operating conditions were maintained constant throughout the investigations discussed: Compression ratio, approximately 14; engine speed, 1000 rpm; glycerine temperature, leaving head, 300° F. Other operating conditions were varied during the tests.

Some of the sequences of high-speed photographs were for the purpose of comparing the effect on combustion of single orifice and multiple-orifice injection nozzles. Fig. 3 shows two common types of injection nozzles. The six orifices used in the multiple-orifice nozzle were designed to produce a fan-shaped spray dispersing fuel droplets as nearly uniformly as possible throughout the flat-disk combustion chamber. The cross-sectional areas of the different orifices of the nozzle were proportioned according to the volume within the combustion chamber that each orifice is intended to fill.

Summary of Results

The summary of results of the studies of fuel injection and combustion by high-speed photography in Mr. Miller's paper is as follows:

"The high-speed photographs demonstrate the better fuel distribution by the multiple-orifice nozzle as compared with the single-orifice nozzle on the basis of actual comparative combustion. They illustrate how Diesel knock, associated with short inflammation time, develops with increasing injection-advance angle. They demonstrate the increasing ignition lag and consequent increased vaporization with increasing injection-advance angle. They also show the increased smoke formation with large injection-advance angles.

"The rare occurrence of a phenomenon probably identical with spark-ignition engine knock has been demonstrated in the Diesel engine. Finally, it has been demonstrated how mixtures too lean for combustion may be formed by early injection with very small fuel quantities, whereas the same mixtures will burn with later injection because of the concentration of the fuel in droplets."

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Chemical Composition and Road Antiknock Performance of Postwar Motor Fuels

By Jane F. Jordan

Wartime advances in refining technique have provided refiners with the means for varying the chemical composition of their motor fuels. This possibility, together with the improved method now in use for indicating the actual road antiknock performance of a gasoline, gives the means for more closely "fitting" commercial motor fuels to actual engine requirements. Among the possibilities suggested is the blending of saturated and unsaturated type stocks; in order to take advantage of the inherently good low speed characteristics of the latter and the inherently good high speed characteristics of the former, thus obtaining maximum advantage of tetraethyl lead additions.

Greater awareness by refiners of the implications of the new refining methods in providing materials for blending into motor fuels, the author states, will permit them to select new equipment which will complement existing plant facilities for the manufacture of improved motor fuels.

NUMEROUS predictions have been made of the probable antiknock levels of postwar motor fuels. The consensus is that regular grade gasoline will be in the neighborhood of 78 to 80 octane number, ASTM Motor method, and that premium grade fuel will be around 83 to 85. Whatever the ultimate levels, postwar motor fuels will be in many respects like their pre-war predecessors, consisting of blends of various refinery stocks and tetraethyl lead.

However, to evaluate these postwar motor fuels solely in terms of their indicated laboratory octane numbers can be distinctly misleading, as this paper proposes to show. Moreover, as will be demonstrated, it does an injustice to the great stride taken in refining technology during the war—which not only has seen the advent of new and improved refining techniques, but has also brought, as a corollary, a greater facility in varying the chemical composition of fuels.

This is borne out by reference to prewar refining experience. Then, the exact composition of a final blend was governed by the necessity of achieving a definite laboratory octane value. Yet it is a familiar fact that fuels of the same octane rating often differ markedly in their performance on the road. If this was apparent before the war, it will doubtless become much more pronounced after the war, when a wide variety of chemical compositions will be possible. As a result of investigations into the road performance of a large number of motor fuel blends, it is believed that the variations of chemical composition with respect to the boiling range of the fuels is of particular importance.

The tremendous advances in refining techniques during the war have placed at the disposal of the oil industry more means of varying the chemical composition of motor fuels than ever before. Pre-war motor fuel blending stocks were limited, in general, to natural, straight-run, thermally cracked, and polymer gasolines, and tetraethyl lead.

After the war, the industry will have at hand the additional components of heavy alkylate, catalytically cracked, hydroformed, superfractionated, and isomerized gasolines. That being the case, it is interesting to consider some of the possibilities for varying chemical composition which these components offer, and more especially, the effect such variations will have on road antiknock performance and road lead susceptibility of the resultant fuels.

The Borderline Knock Test Method

All of the road test work upon which this discussion is based was done by the Borderline Knock Test Method, adopted by the Cooperative Fuel Research Committee as a standard procedure in 1940. Previously, road testing of fuels had been carried out by the CFR Uniontown method, in which the test fuels were bracketed on the basis of maximum knock intensity between secondary reference fuels of known octane number, very much as laboratory octane numbers are determined. As a matter of fact, the ASTM Motor method of laboratory knock testing was designed to give results which would correlate with those obtained on the road by the CFR Uniontown method.

At the time the ASTM Motor method was adopted in 1932, it did a fairly good job; the fuels which did not fit its pattern were relatively few. However, the rapid developments in refining methods since that time have led to the production of more and more gasolines which show better antiknock performance in cars on the road than is indicated by their Motor method ratings in the laboratory. This has suggested the need for greater reliance upon road testing as a truer measure of antiknock quality. Consequently, a lot of study has been devoted to the development of improved knock testing methods.

As a road test procedure, the Uniontown method has many uses. But for studying the effects of chemical composition on road antiknock performance, it has one great disadvantage. This is, that it rates fuels on the basis of knock intensity irrespective of the speed range in which the knock occurs. Thus, a straight-run and a cracked gasoline may both be assigned a road octane number of say, 80. Yet the typical curves of knock intensity versus engine speed will show that the straight-run fuel develops its maximum knock at low speeds, while the cracked gasoline develops maximum knock at high speeds. Furthermore, the Uniontown method gives an investigator no idea of the road antiknock characteristics of the test fuel in the speed range in which it doesn't knock, thereby limiting its usefulness.

The Borderline Knock Test Method, on the other hand, gives more information of the type sought by automotive engineers and petroleum technologists. Whereas the Uniontown method assigns a single road octane number to a test fuel, the Borderline method indicates the road antiknock performance of a gasoline by means of a curve. This borderline knock curve shows graphically a fuel's ability to tolerate spark advance throughout the entire engine speed range. As its name implies, it represents the dividing line between knocking and nonknocking operation. For testing by this method, a test car is equipped with a fixed or non-automatic distributor that can be varied manually by the driver, a suitable spark advance indicator, and an engine tachometer.

The procedure for determining the borderline curve for a fuel is as follows:

The spark is set manually to a relatively low advance, usually 2 to 6 degrees before top dead center. The car is slowed down to as low a speed as possible in high gear, generally about 6 to 8 mph, and then accelerated with wide open throttle. As the engine picks up speed, the knock intensity lessens, and

Presented before the Tenth Annual Petroleum Meeting of the Wichita, Kans., Section, American Chemical Society, May 17, 1945.

The author, Miss Jane F. Jordan, is a member of the Technical Service Department, Ethyl Corp., New York.

Note. It is understood that some minor changes may be made in the text of this paper before its official publication by the American Chemical Society.

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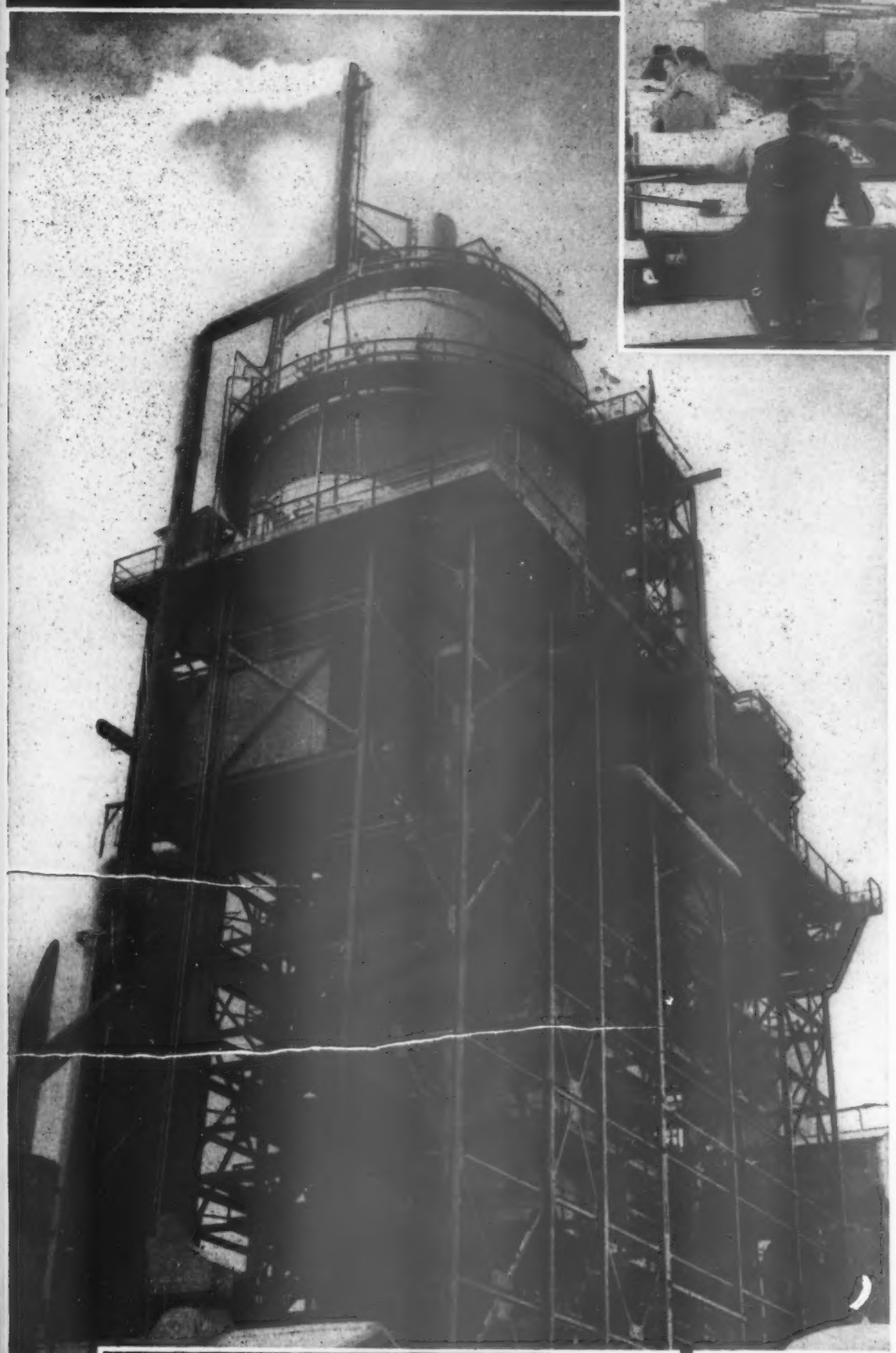

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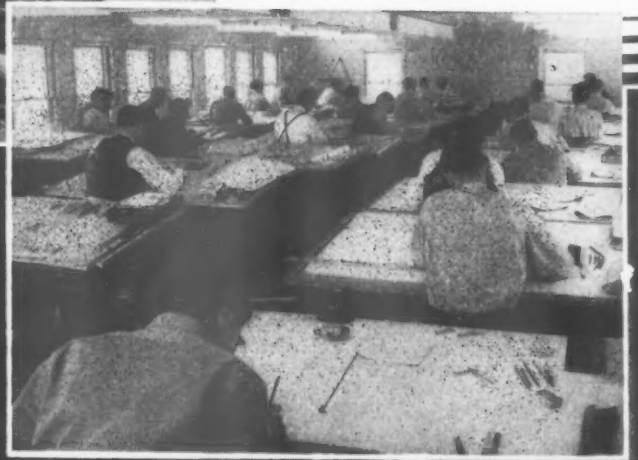

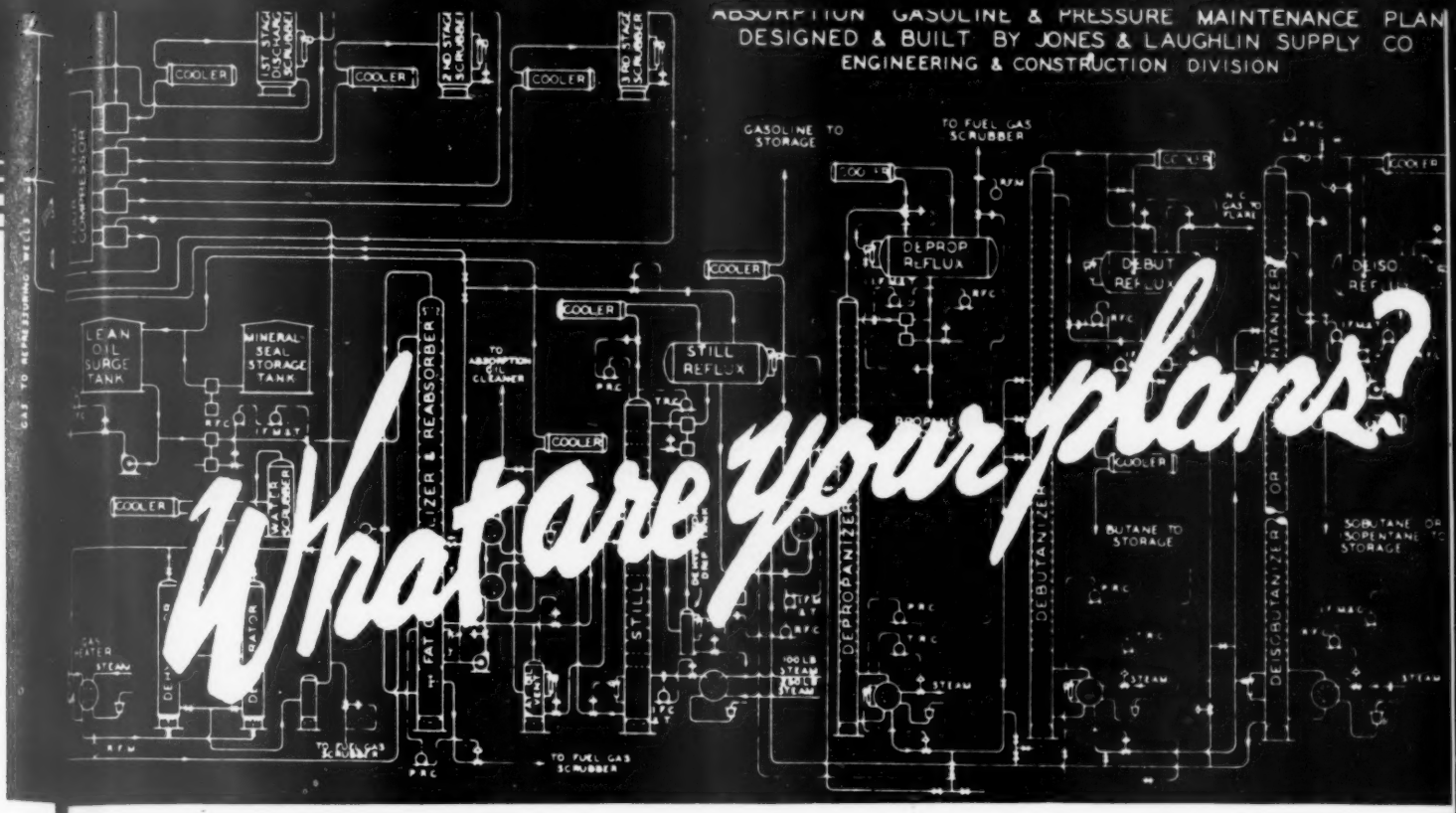

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the speed at which the knock dies out is noted. This gives one point on the borderline curve, representing the two dimensions on the chart: spark advance (vertical axis) and knock-die-out speed (horizontal axis). The spark is then advanced 2 degrees and the entire procedure repeated to obtain the second point on the curve. This process is continued until the complete curve has been established for the entire spark advance and speed range under consideration.

Borderline test data usually are plotted as shown in Fig. 1. The light dotted line represents the distributor spark advance curve for the particular engine in which these tests were conducted. For a fuel not to knock in this car, it must be able to tolerate at least as much spark advance at all speeds as that normally produced by the distributor advance mechanism. Wherever the solid line representing the borderline curve for the test fuel falls below the distributor spark advance curve, the engine is considered to be knocking. The borderline curve for the fuel in question indicates that it will knock at relatively low speeds in the range from 700 to 1800 rpm. In this example, the actual knock-die-out points, obtained on the road, are indicated by the heavy dots to illustrate the number of points obtained in the development of a curve of this type. The individual points are not shown on the borderline curves subsequently presented, but they are all obtained and recorded in a similar manner.

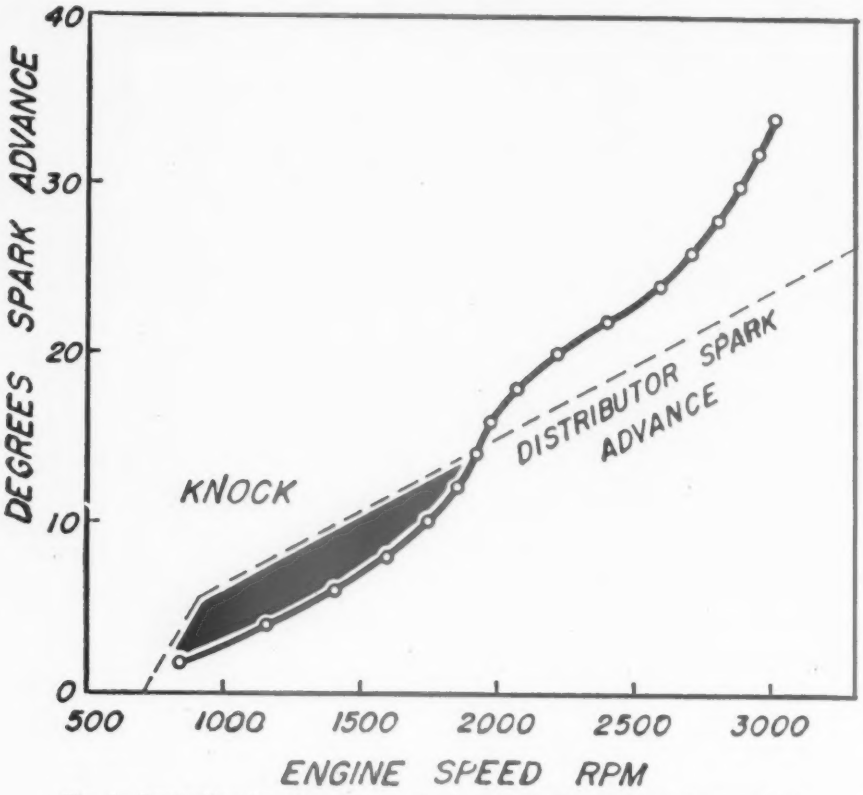

Fig. 1—Borderline knock curve; method used to obtain curve for any fuel

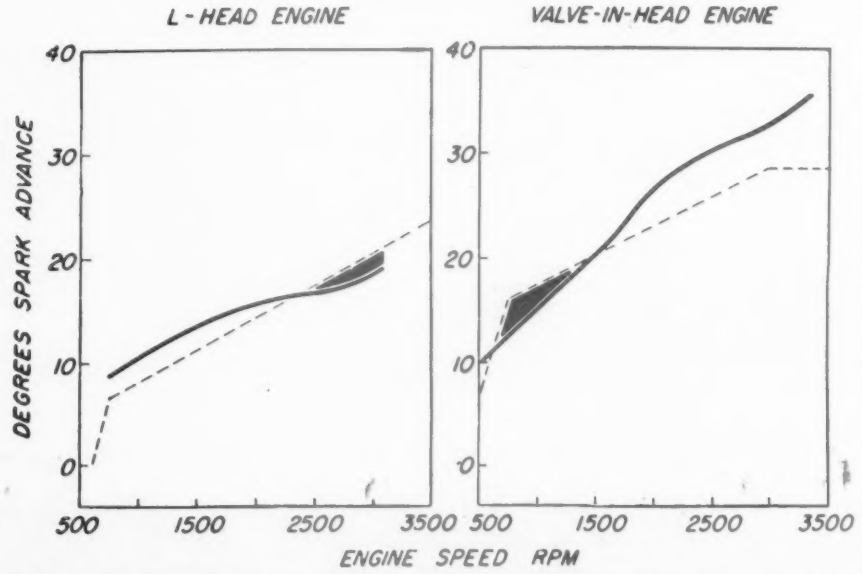

Fig. 2—Borderline knock curves for blended gasoline in L-head and valve-in-head engine

It should be pointed out that the borderline curves, obtained by this procedure, are indicative of the antiknock characteristics of the test fuel only in the particular engine in which the tests were conducted. Engines too, differ in their knocking tendencies. In general, the valve-in-head engine is inclined to knock more at low speeds than the L-head engine while the latter generally knocks more severely in the higher speed ranges. This is demonstrated in Fig. 2, which shows borderline curves of the same test fuel determined in the two types of engines.

Because of this variation in engines, it is advisable to determine the borderline curves of test fuels in at least one and preferably duplicate engines of each type. The present work was done in representative engines of both types. Many of the curves used are presentations of the data from one car or the other only. But this has been done merely to simplify the discussion and to stress the essential fuel characteristics which are the particular point of interest here.

Fundamental Variations in Fuel Types

Using the borderline method, it is possible to demonstrate the fundamental differences in the road antiknock characteristics of the various fuel types. Take, for example, a saturated type fuel which is similar chemically to the straight run gasolines marketed before the war. Borderline curves for this fuel, clear and with three different concentrations of tetraethyl lead, are shown in Fig. 3.

On the basis of improvement in laboratory octane numbers, this gasoline is very susceptible to tetraethyl lead. The addition of 3cc. of lead per gallon raises the Motor method octane rating 13.5 numbers. On the road, however, the principal effect of the TEL addition is to improve the high speed performance of the fuel out of all proportion to the improvement gained at low speeds. Since the saturated type fuel is inherently good at high speeds and deficient in antiknock quality at low speeds, the tetraethyl lead is of relatively small benefit—measured in actual road performance—in spite of the excellent boost it promises from laboratory octane ratings. This is shown by the almost perpendicular character of the borderline curves of the leaded fuels.

At the same time, as an inspection of Fig. 3 shows, a satisfactory fuel—that is, one which will satisfy the spark advance requirements of the engine over

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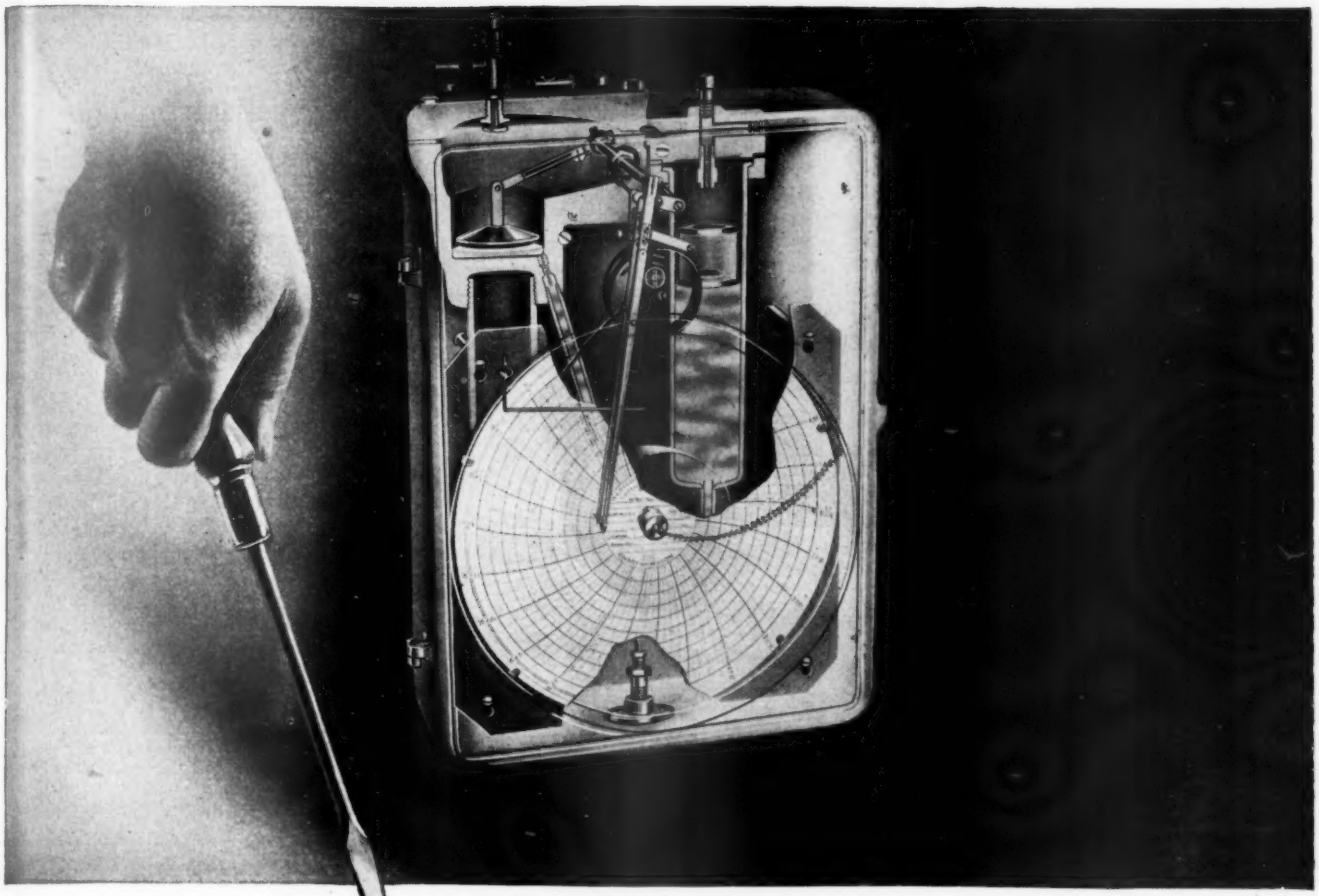

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the entire speed range—can be made by the addition of a little more than 1.5 cc. of tetraethyl lead per gallon, probably 1.6cc. This is indicated by Curve C which lies above the distributor spark advance curve at all speeds above about 800 rpm. Such a fuel would rate about 90 octane number by both the Motor and Research methods, since this is what is normally termed an "insensitive" type of gasoline.

In contrast, Fig. 4 presents the borderline curves, clear and with the same concentration of tetraethyl lead as in Fig. 3, of a highly unsaturated type of gasoline. In terms of laboratory octane ratings, this is a very "sensitive" gasoline —showing a spread of 12.5 octane numbers between its Motor and Research method ratings. At the same time, it has very poor lead susceptibility. The addition of 3 cc. of lead to this fuel raises its antiknock value by only 3 laboratory octane numbers.

Nevertheless, this gasoline is more suitable for the engine than the saturated type of fuel—despite its tendency to knock in the high speed range. As with the saturated fuel in Fig. 3, the addition of tetraethyl lead to this unsaturated fuel improves its high speed performance. But since, in this case, the fuel is inherently good at low speeds and weak at high speeds, the TEL is now complementing the natural properties of the gasoline. More than that, it demonstrates that the gain in road performance—where it is needed—may be more important than the small gain in laboratory octane numbers would indicate. A satisfactory fuel for the engine could be made from this unsaturated stock with the addition of a very small amount of tetraethyl lead: about 0.2 cc. per gal. The resulting fuel would have a Motor method rating of about 82.5 and a Research rating of about 95.

It is obvious that, technically, a more suitable fuel than either of the foregoing would be one with a borderline curve which was parallel and slightly above the distributor spark advance curve of the car throughout the entire speed range. This would insure knock-free operation at all speeds without "wasting" antiknock quality at any speed. It may be more economic, of course, to produce a fuel like those shown in Figs. 1 and 2 with "excessive" antiknock value in some part of the speed range. The possibility of blending the saturated and unsaturated type stocks—in order to take advantage of the inherently good low speed characteristics of the latter and the inherently good high speed characteristics of the former—immediately comes to mind.

Borderline curves for such a fuel, a 50-50 blend of the two previously illustrated stocks, clear and with various concentrations of tetraethyl lead, are shown in Fig. 5. The tetraethyl lead susceptibility of this combination of gasolines, by laboratory knock testing methods, is about the average of the two stocks taken separately; 7 octane numbers with 3 cc. of lead. The road response is more "even" than for either stock alone, although here again there is a definite tendency to effect more improvement at high speeds than at low speeds, especially with high tetraethyl lead concentrations. The addition of about 0.7 cc. of tetraethyl lead to this blend results in a fuel which will satisfy the distributor spark advance requirements of the test car throughout the entire speed range. This fuel has a Motor method rating of about 85 and a Research rating of about 90 octane number.

Road antiknock curves obtained on a number of commercial gasolines prior to the war indicate that the average prewar fuel was a good deal like the foregoing 50-50 blend in sensitivity, lead susceptibility, and road performance. In general, these fuels tended to knock at low speeds, so that it appears reasonably accurate to state that an improvement in the low-speed antiknock characteristics of fuels is generally desirable. This statement must be qualified by adding, "for the present type of naturally aspirated gasoline engine." Obviously, engine developments in the postwar period, which will alter the fuel requirements of the engines, are quite possible.

For example, the effect of a new type transmission, which would prevent loading the engine below 1500 rpm, cannot be discounted. Such a development would make low speed antiknock quality relatively unimportant. Similarly, supercharging may be expected to influence the relation of fuel type to engine requirement. Such possibilities are outside the scope of this discussion, but they should be kept in mind. It is reasonable to expect, however, that for a period of years after the war there will be large numbers of the present type of gasoline engines on the road, and the statements made here are generally applicable to them.

The desired improvement in low speed antiknock performance—and the

FUEL NO	TEL CC/GAL	OCTANE NUMBER MOTOR	OCTANE NUMBER RESEARCH	CAR	
A	0.0	80.0	80.5	YEAR	1941
B	0.5	85.0	86.0	COMP. RATIO	8.0-1
C	1.5	89.5	90.5	NO. CYL'S	8
D	3.0	93.5	93.0	HEAD TYPE	C.I.

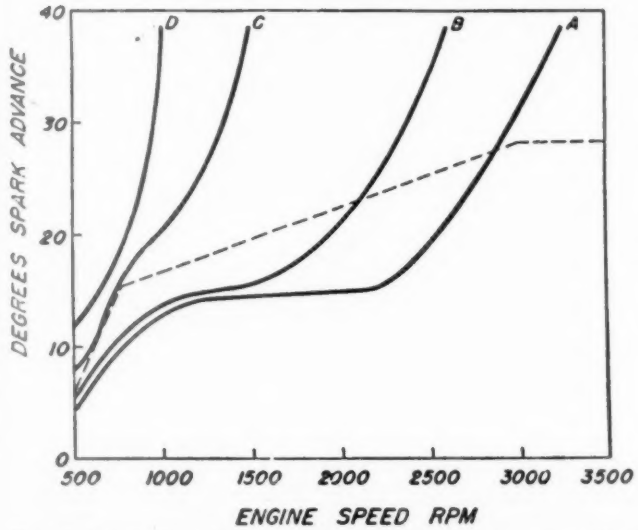

Fig. 3—Borderline knock curves; saturated type gasoline showing road lead susceptibility

FUEL NO	TEL CC/GAL	OCTANE NUMBER MOTOR	OCTANE NUMBER RESEARCH	CAR	
A	0.0	82.0	94.5	YEAR	1941
B	0.5	82.5	96.5	COMP. RATIO	8.0-1
C	1.5	84.0	98.0	NO. CYL'S	8
D	3.0	85.0	99.0	HEAD TYPE	C.I.

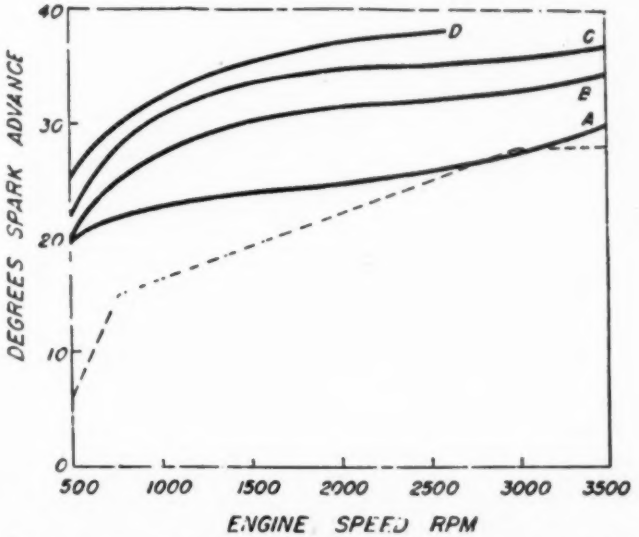

Fig. 4—Borderline knock curves; unsaturated type gasoline showing road lead susceptibility

FUEL NO	TEL CC/GAL	OCTANE NUMBER MOTOR	OCTANE NUMBER RESEARCH
A	0.0	81.0	87.0
B	0.5	83.0	89.5
C	1.5	86.0	93.0
D	3.0	88.0	95.0

CAR	
YEAR	1941
COMP RATIO	80-1
NO CYL'S	8
HEAD TYPE	C.I.

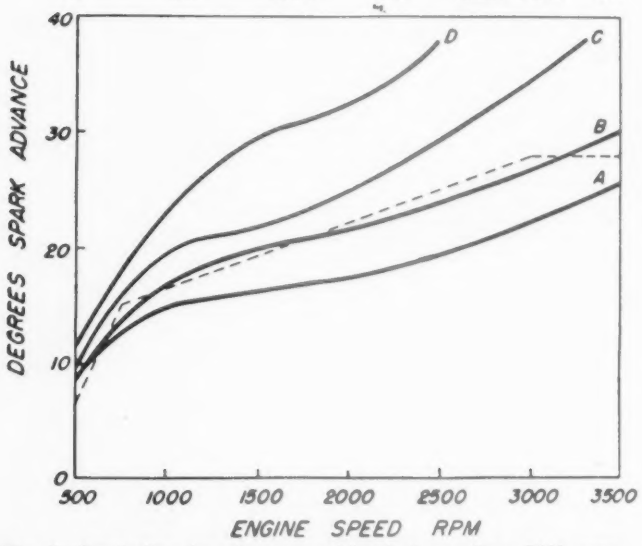

Fig. 5—Borderline knock curves: blended gasoline, 50% saturated-50% unsaturated, showing road lead susceptibility

FUEL NO	TEL CC/GAL	OCTANE NUMBER MOTOR	OCTANE NUMBER RESEARCH
A	0.0	79.0	88.0
B	0.5	82.0	91.5
C	1.5	85.5	94.0
D	3.0	87.0	97.0

CAR	
YEAR	1941
COMP RATIO	8.0-1
NO CYL'S	8
HEAD TYPE	C.I.

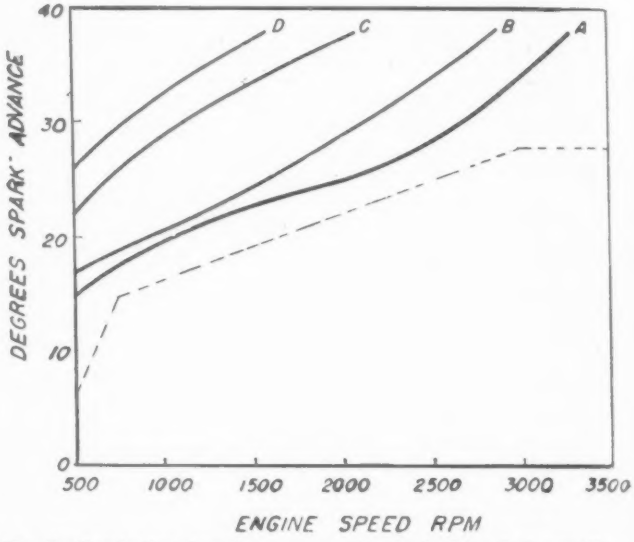

Fig. 6—Borderline knock curves: selectively blended gasoline showing road lead susceptibility

achievement of a better "fit" in general between engine and fuel—can be accomplished by controlling the distribution of hydrocarbon type with respect to the distillation range of the blend. The variety of new fuel types made available during the war permits innumerable combinations in which this can be done.

One such "special blend" is illustrated in Fig. 6, showing borderline curves for the fuel, clear and with various additions of tetraethyl lead. Such a fuel not only conforms nicely to the distributor spark advance curve of the car in the unleaded state, but the addition of tetraethyl lead effects an almost uniform improvement in both low and high speed antiknock quality, so that this conformity is retained at all octane levels. In this case, the unleaded fuel, having a Motor method rating of about 79 and a Research rating of about 88 octane number, is entirely satisfactory for the car.

It is interesting to review the antiknock characteristics of the four fuels just discussed, as shown in Table 1.

Here are four fundamentally different fuels. They vary by as much as 11 octane numbers by the laboratory Motor method. In consequence, one would have superficially expected a wide variance in their road antiknock performance. But as the foregoing discussion tried to show, these four different fuels have essentially comparable road antiknock performance—as judged by their ability to satisfy the distributor spark advance requirement of the engine.

In other words, with the proper combination of blending stocks and tetraethyl lead, it is possible to produce a fuel, like the special blend of only 79 Motor method octane number, that has better road antiknock performance—throughout the entire speed range—than a fuel of higher Motor method ratings like the saturated fuel of 90 octane number. This, then, should demonstrate the fallacy in blending to a given laboratory octane number, as a criterion of fuel quality, without full appreciation of the inherent road antiknock characteristics of the particular blend.

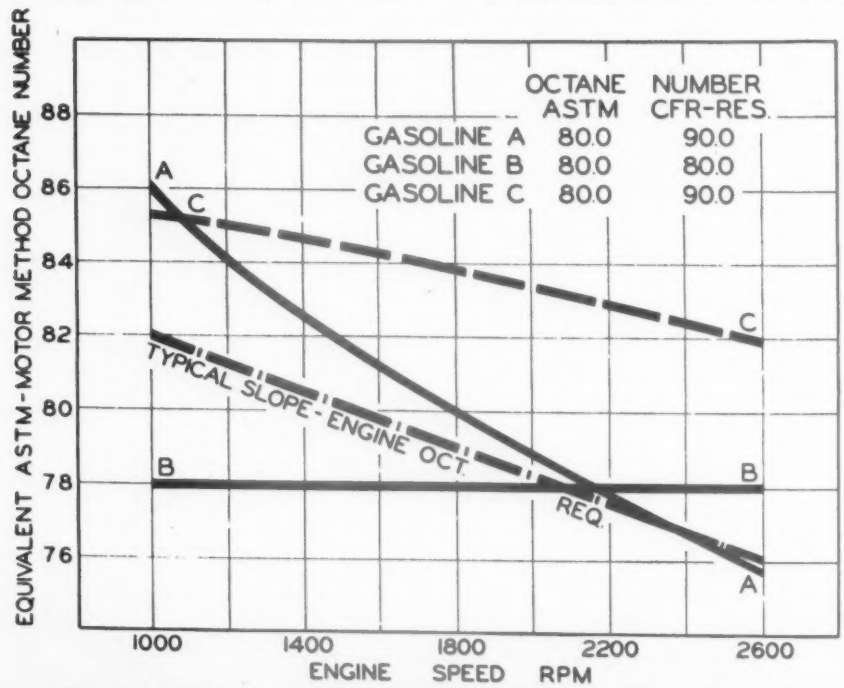

Fig. 7—Variation in equivalent ASTM octane number with engine speed

Sensitivity as a Criterion of Fuel Quality

It is sometimes thought that the principal factor of importance in road antiknock performance is "sensitivity"; that is, the spread between laboratory ratings by the Motor and Research methods. It is only necessary to consider that the special blend in the preceding illustrations—the most satisfactory of the four fuels—has a spread of only 9 oc-

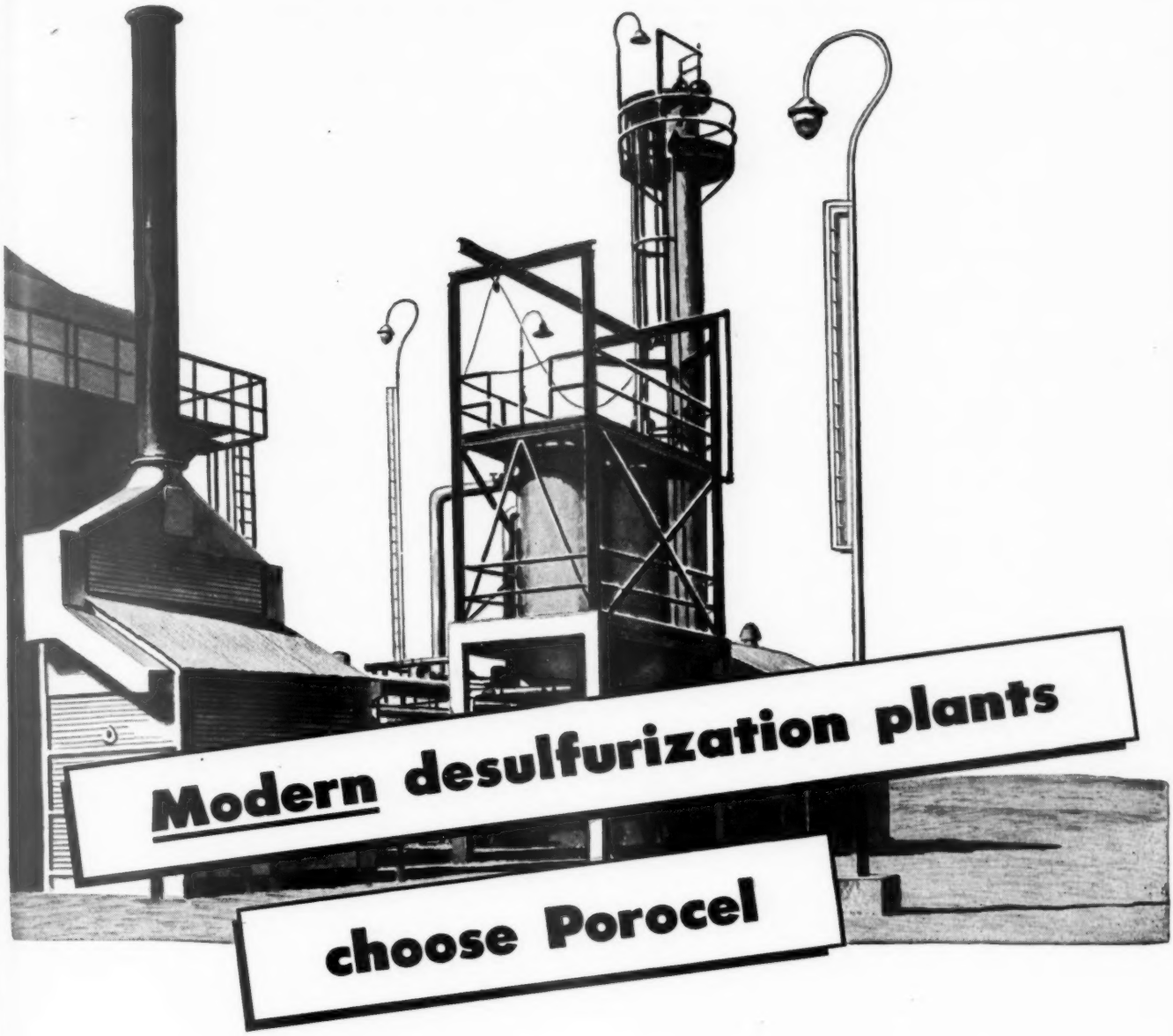

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TABLE 1—Antiknock Characteristics of Four Motor Fuels

Type of Gasoline	Octane Number ASTM Motor	CFR Research
Saturated	90.0	90.0
Unsaturated	82.5	95.0
50-50 Blend	85.0	90.0
Special Blend	79.0	88.0

tane numbers between Motor and Research ratings while the unsaturated fuel has a spread of 12.5 octane numbers; obviously, sensitivity is not the sole explanation.

This point is particularly well illustrated in Fig. 7. Fuels A, B and C are three commercially possible motor fuels, all rating 80 octane number by the Motor method. Fuel B is an "insensitive" type, such as a straight-run gasoline. Fuels A and C are "sensitive" gasolines showing a spread of 10 octane numbers between Motor and Research ratings.

The three fuels perform very differently on the road. The dot-dash line of typical slope of engine octane requirement was constructed from numerous data on heavy duty commercial type engines. It illustrates the well known fact that the average engine requires a better fuel, in terms of octane number, at low engine speeds than it does at higher speeds. Here, engine octane requirement, in terms of Motor method octane number, is approximately 82 at 1000 rpm while at 2600 rpm a fuel of about 76 is adequate. The insensitive fuel B rates about 78 octane number throughout the entire engine speed range, that is, slightly below its Motor method octane number.

Since this is considerably below the requirement of the average engine illustrated at speeds up to 2000 rpm, an 80 octane, Motor method, gasoline of this type probably will knock excessively in an average engine designed to run on 80 octane fuel. This is because Fuel B happens to be a kind which does not show up well on the road. Fuel A is typical of the customary "sensitive" type gasolines. It has excellent low speed antiknock characteristics, but tends to knock slightly in the higher speed ranges above 1900 rpm. Fuel C, however, is a specially blended "sensitive" type fuel. On the road it has much better antiknock qualities over the entire speed range than Fuel A, and, in particular, does not break down at high engine speeds.

Special Blending: Effect of Type of Light Blending Materials

There are no hard and fast rules which dictate the methods of special blending. It can be defined no further than to say it is the adjustment of chemical composition with respect to the boiling range of the fuel in such a way as to obtain the best "fit" between the fuel requirements of the particular engine or engines in which the investigator is interested and the engine response of the fuel. Over a period of years, and through the testing of hundreds of different fuel blends, some of the factors in the process of special blending have been fairly well established. On the basis of the work carried out by our own laboratory, it is believed that one important factor is the concentration of the highly unsaturated components in the light boiling range of the fuel and the concentration of the highly saturated materials in the heavier boiling fractions. This is of prime importance from the standpoint of road antiknock performance, which, after all, is where fuel quality counts.

The importance of the type of light blending material is shown in Figs. 8 and 9. This series of fuels was prepared, using as a base a regular grade gasoline containing approximately 70% of high pressure thermally cracked gasoline and 30% of low end point straight-run gasoline from Illinois crude oil. This base fuel was stripped through the C_5 fractions, the material removed constituting about 19% of the total fuel. To 81% of the stripped base were then added 19% of each of the light blending agents tested.

Road and laboratory knock ratings were made on the fuels, clear and with additions of 0.5, 1.5 and 3.0 cc. of tetraethyl lead per gallon. The borderline curves given here show only the fuels containing 3 cc. of lead, primarily for simplification, and also because this discussion is concerned with possible postwar fuels. Similarly, data are shown for only one car, although ratings were obtained in both a valve-in-head and an L-head engine. This work was carried out in cooperation with the Pure Oil Co. and the author is indebted to that company for permission to use the data obtained.

The light paraffinic blending agents (Fig. 8) effect changes in the road anti-

FUEL NO	DESCRIPTION	OCTANE NUMBER MOTOR	RESEARCH	CAR	
A	BASE FUEL	79.5	85.5	YEAR	1942
B	+N-PENTANE	77.0	84.0	COMP. RATIO	7.5 to 1
C	+ISOPENTANE	80.0	87.0	NO. CYLS.	8
D	+NEOHEXANE	80.0	89.5	HEAD TYPE	L-HEAD

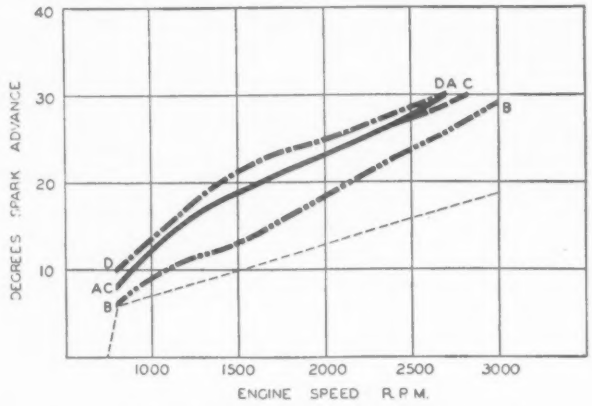

Fig. 8—Light saturated blending agents

FUEL NO.	DESCRIPTION	OCTANE NUMBER MOTOR	RESEARCH	CAR	
A	BASE FUEL	79.5	85.5	YEAR	1942
B	+PENTENE-2	79.0	89.5	COMP. RATIO	7.5 to 1
C	+TRIMETHYL ETHYLENE	79.5	91.0	NO. CYLS.	8
D	+CYCLOPENTANE	80.5	88.0	HEAD TYPE	L-HEAD

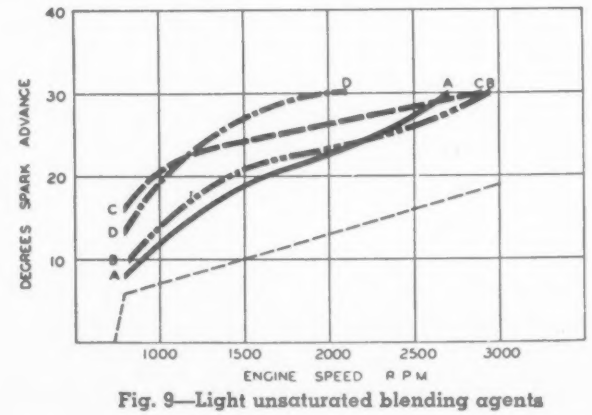

Fig. 9—Light unsaturated blending agents

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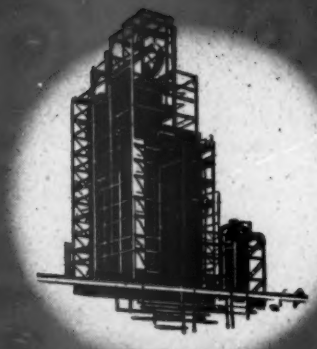

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FUEL NO.	TEL. ml/GAL.	OCTANE NUMBER MOTOR	RESEARCH
A	0.0	79.0	88.0
B	0.5	82.0	91.5
C	1.5	85.5	94.0
D	3.0	87.0	97.0

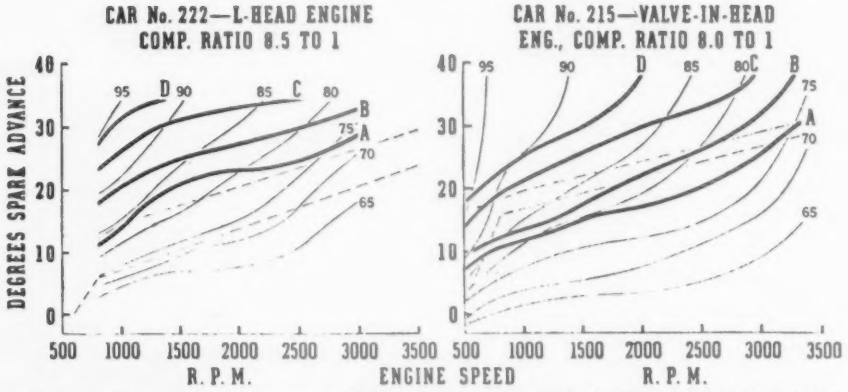


Fig. 10—Borderline knock curves—50% vapor-phase cracked gasoline, initial boiling point to 275 F.; 50% heavy alkylate

knock characteristics of the base fuel, which are roughly in line with the indicated changes in laboratory octane number. Thus, substitution of *n*-pentane drops the Motor method rating of the base fuel about 2.5 octane numbers, and there is a corresponding derating on the road. Conversely, isopentane and neohexane improve the laboratory ratings of the base somewhat, and the road ratings of these blends are as good or slightly better than that of the base fuel. In all cases, however, the borderline curves of the blends parallel the borderline pattern of the base fuel.

The substitution of the olefinic blending agents, on the other hand, (Fig. 9), makes a marked improvement in low speed antiknock performance of the base fuel. The normal olefin is less effective than the highly branched trimethylethylene, of course, which is in keeping with the general superiority of branched chain compounds over their straight chain isomers. As a result of the improvement in low speed performance, the over-all borderline curves tend to parallel the distributor advance curve. Thus, it would be possible to advance the basic timing by about 9 degrees and yet have this engine operate satisfactorily on the fuel containing trimethylethylene.

It is particularly interesting, and not immediately explainable, that cyclopentane proves to be one of the best low speed antiknock agents of all the C_5 and C_6 hydrocarbons tested in this series. Although it is a naphthene, and thus would be expected to act more or less as the paraffins do, it actually has the same type of effect on low speed performance as an olefin. It is almost as good at 1000 rpm as trimethylethylene. The curves in Fig. 9, being for one lead concentration only, do not demonstrate the advantages of light olefinic type materials in improving low speed lead susceptibility as well as low speed antiknock performance.

Using this principle of concentrating unsaturated material in the front end and saturated components in the heavy end, the best fuel made in the laboratory up to the present time is shown in Fig. 10. This fuel contains 50% of vapor phase cracked gasoline boiling up to about 275°F. and 50% of heavy alkylate having a boiling range of approximately 300 to 400°F. Here, for the first time, are shown all the curves obtained in road testing such a fuel. The borderline data obtained in the L-head and the valve-in-head engines are shown side by side. The maximum power spark advance curve is shown, as well as the distributor spark advance curve, the former by the dot-dash line, the latter by the dotted line.

The light solid lines in the background give the secondary reference fuel pattern, the Motor method octane number of each being shown at the end of the line. It is possible to interpolate between them and determine the road octane number of the test fuels at any given engine speed, if this is considered advantageous. As a practical matter, the reference fuel pattern is simply a standard for judging the reasonableness of the test results obtained on any given day and a check on the "normalcy" of the engine itself.

It will be noted that the borderline curves of this special blend, with and without the addition of tetraethyl lead, parallel the distributor and the maximum power spark advance curves of the cars. This is true even in the valve-in-head engine, which tends to knock at low speeds. In particular, lead additions to such a fuel produce practically equal rises in antiknock quality throughout the speed range with each succeeding lead addition. The addition of 1.5 cc. of tetraethyl lead to such a fuel gives a gasoline of about 85 Motor method and 94 Research method octane rating. This has sufficient antiknock performance throughout the speed range to permit the spark to be advanced to maximum power spark setting in both the L-head and valve-in-head engines of 8.5 and 8.0 to 1 compression ratio, respectively.

Special Blending: Effect of Olefins in the High Boiling Range

A second general principle of special blending appears to be that the presence of olefinic material in the heavy end of the fuel not only affects high speed antiknock performance but also has a deleterious effect on low speed lead susceptibility.

This is demonstrated in Figs. 11 and 12. In Fig. 11 are shown the borderline curves, with and without tetraethyl lead, of a first-pass catalytically cracked gasoline. It is a "cat" cracked fuel made rather early in the development of the process; for that reason, it may not be typical of the catalytically cracked materials which will be made when these units are con-

FUEL NO.	TEL. ml/GAL.	OCTANE NUMBER MOTOR	RESEARCH
A	0.0	77.0	90.0
B	0.5	79.5	92.5
C	1.5	83.0	94.5
D	3.0	84.5	96.0

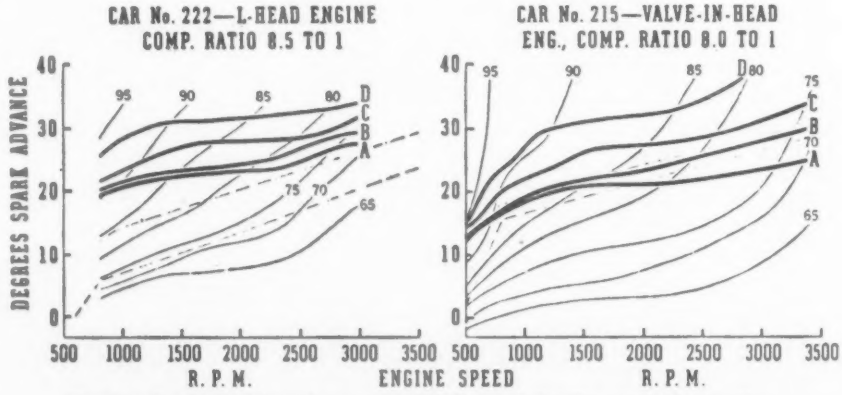
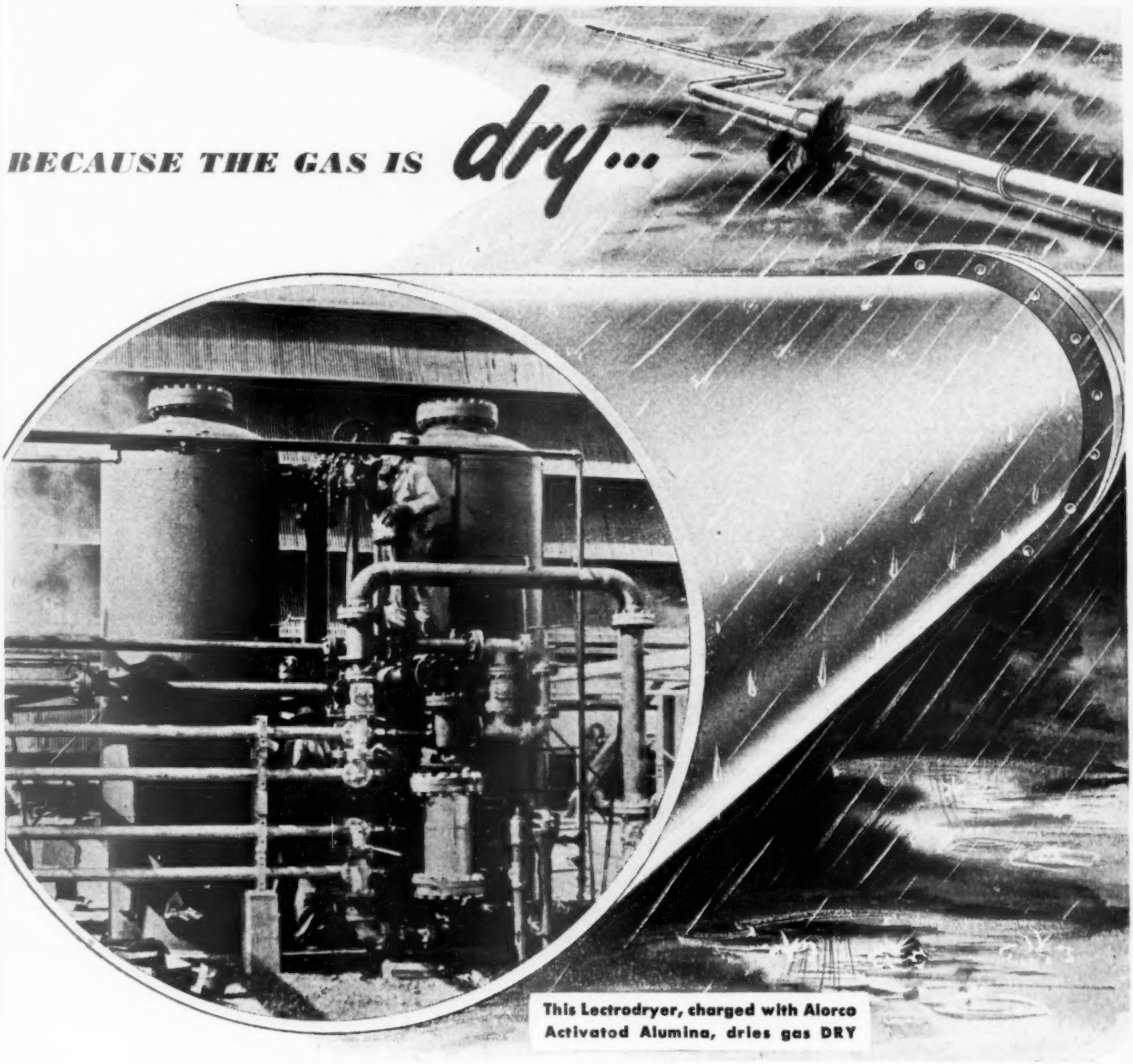


Fig. 11—Borderline knock curves—100% catalytically cracked gasoline

BECAUSE THE GAS IS *dry...*



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ALORCO

Aluminas and Fluorides

FUEL NO.	TEL. ml/GAL.	OCTANE NUMBER MOTOR	RESEARCH
A	0.0	80.0	91.0
B	0.5	82.5	95.0
C	1.5	84.5	96.5
D	3.0	85.5	97.5

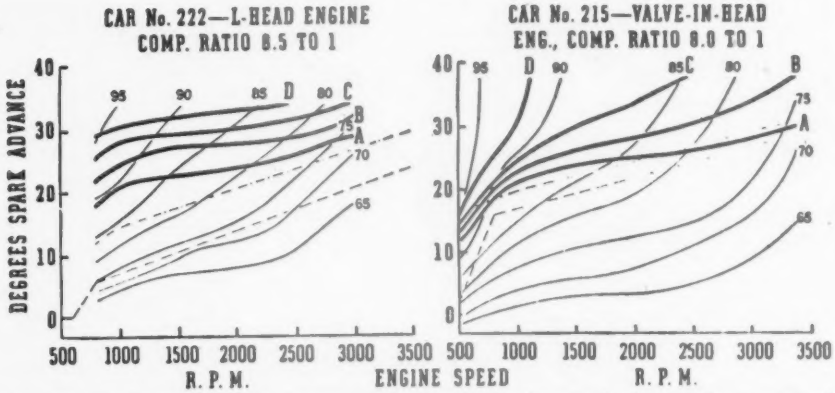


Fig. 12—Borderline knock curves—90% catalytically cracked gasoline, approximately 300 F. end point; 10% heavy alkylate, approximate boiling range, 300 to 400 F.

verted to motor fuel production in the postwar period. The curves indicate a tendency to knock at high speeds and a relatively good low speed antiknock performance typical of the unsaturated type gasoline. The low speed lead susceptibility of this fuel is not particularly good.

Fig. 12 presents the borderline curves of this same catalytically cracked fuel in which the last 10% of the gasoline has been replaced with 10% of 300-400°F. boiling range heavy alkylate. The substitution of saturated for the unsaturated components in this portion of the boiling range has improved lead susceptibility throughout the speed range and has produced a fuel more nearly paralleling the distributor spark advance curve of the cars.

It is interesting to compare these catalytically cracked base fuels with the thermally cracked base fuel shown in Fig. 10. The same amount of tetraethyl lead is required in the 100% catalytically cracked gasoline, 1.5 cc. per gal., to produce a fuel satisfactory for the two types of engines as was required for this purpose by the vapor phase-alkylate blend. Such a fuel rates 83, Motor method, and 94.5, Research method. It is more sensitive than the thermal base blend, but the latter is a much better fit for the engine and allows a more comfortable cushion of performance. The substitution of 10% of heavy alkylate in the high boiling range, however, permits the production of a satisfactory fuel from the catalytically cracked gasoline with the addition of only 0.5 cc. of tetraethyl lead per gallon.

Obviously, commercial fuels cannot be made by cutting up the various refinery stocks, using the desirable portions, and throwing the rest away. There are, however, some general ways in which improvements can be made in average fuels to alter their composition so that they tend to approach the type of fuel whose borderline pattern parallels the distributor spark advance curve of the average automotive engine. For example:

1. By substituting a small amount of high boiling paraffinic, naphthenic, or aromatic material for the high boiling olefinic hydrocarbons normally contained in highly cracked fuel.

2. By adding light olefinic or aromatic material to a straight-run fuel.

3. By blending refinery stocks with due consideration to the effect of such blending on the road lead susceptibility of the fuel throughout the speed range, so that the maximum advantage is obtained from the lead additions.

4. By using light olefinic material rather than light paraffinic material to adjust volatility.

Even better from the point of view of use of these principles in full-scale plant operation would be the discovery of some means of making it practical to cut saturated and unsaturated type stocks in half, and deolefinize the heavy unsaturated material and dehydrogente the light saturated material before recombining them. This, of course, is expensive. But with the advances in refining technique in these past war years as tools, such a possibility is not altogether far-fetched.

This discussion has attempted to show the greater meaning of the actual road antiknock performance of motor fuels over their indicated laboratory numbers. More, it has demonstrated, it is hoped, that greater possibilities for improving fuel performance are possible with recent refining methods than have been realized to date. At the very least, greater awareness of the implications of the newer refining methods for improving the road antiknock characteristics of motor fuels will permit the selection of new equipment which will complement existing plant facilities.

One of numerous gas processing plants designed and constructed by Petroleum Engineering, Inc. during its 16 years of service to the industry. Petroleum Engineering, Inc. Offices: Tulsa and Houston.

Photographed for Petroleum Engineering, Inc.
By Robert Yarnall Richie

INDUSTRIAL LUBRICATION

By W. G. Forbes

6—Lubrication of Internal Combustion Engines

W. G. Forbes, who had been contributing this regular feature to the *NPN Technical Section* since last May, was drowned July 29. He was Lubricating Engineer for the Tide Water Associated Oil Co., New York.

Before his death, however, Mr. Forbes had prepared a number of installments of his material in advance and submitted them to the editors. We will attempt to continue presenting his valuable contributions to the literature in the field of industrial lubricants and industrial lubrication as long as they are available.

Q—What is the cause of bearing corrosion in gasoline and Diesel engines, particularly in the small high speed types?

A—The principal cause of bearing corrosion is the chemical action of compounds produced by oxidation which accumulate in the oil charge and attack bearing metals such as copper-lead and cadmium-silver. These compounds, which are generally of an acidic nature, develop with service in the crankcases of small internal combustion engines because the charge is confined to a small space and is subjected to high operating temperatures in the order of 225° F. to as high as 350° F. in the crankcase and piston crown temperatures above 600° F.

Under these conditions the process of deterioration is greatly accelerated because high temperatures promote a comparatively rapid rate of chemical union between oxygen in the air and an increasing but relatively small percentage of the oil charge. This action is termed oxidation and results in forming compounds which in turn generally promote the formation of crankcase deposits, sludges, and emulsions. However, most authorities seem to agree that an excessive quantity of these compounds produced by high temperatures will cause bearing corrosion.

This matter is difficult and complex to analyze or predict on a general scale, because lubricating oils are made from many different types of crude, but regardless of technical theories and details the problem of bearing corrosion has been verified by laboratory research and conclusively traced to the action of compounds developed in the oil charge, generally an excess of acidic compounds.

Curiously enough, babbitt metal is practically immune to this particular action but unfortunately babbitt metal is comparatively soft, and, therefore, not so well adapted to the crank pin bearings of high speed engines as the harder bearing metals such as copper-lead, cadmium-silver, etc. However, babbitt metal is used for high speed bearings by employing a comparatively thin layer on a harder metal backing.

Q—What is the effect of fuel dilution on lubricating oils?

A—Taking kerosine as a standard, each 5% of dilution will just about lower the viscosity of an oil by one SAE number. For example, 5% of fuel dilution will reduce an SAE 30 oil to an SAE 20 oil. If 10% of dilution is present in an SAE 30 oil the SAE viscosity rating would be reduced to about SAE 10. Another effect of dilution is to lower the flash and fire point of the oil.

In cold climates where sub-zero conditions are encountered and automotive equipment has to be started at temperatures around —30° to —50° F., the crankcase oil is sometimes diluted with anywhere from 10% to 30% of gasoline in order to make starting possible. While not a very commendable practice, it is often a matter of necessity to dilute the cold or frozen crankcase oil, and, as a rule most of this dilution will evaporate as the engine warms up.

When this practice is followed the engine should be run idle for about 20 minutes after the cooling water, etc., has reached a normal operating temperature. Then the engine should be stopped and the oil level checked.

Q—Why are engines equipped with aluminum piston heads easier to lubricate than engines equipped with cast iron piston heads?

A—Piston heads made of aluminum and aluminum alloys transfer heat more readily than cast iron. Consequently they operate at a lower temperature, all other operating conditions being equal. This factor is obviously an advantage, not only from the viewpoint of lubrication, but from the actual tendency of piston rings to collect deposits in their grooves, which in turn, tend to bake and freeze the rings under high temperature operating conditions.

Many investigations have been carried out to find out just how a piston transfers heat to a cylinder wall and thence to the cooling water. Some authorities state that most of this heat passes from the rings to the cylinder walls while others state that most of this heat is transferred to the cylinder walls by the piston head. Regardless of this controversial matter, it is a fact that aluminum pistons operate at lower temperatures, and piston rings are noticeably cleaner with this type of head.

Q—Why is chromium plating employed to surface cylinder walls?

A—Cylinder walls have a comparatively rough surface after completion of the machining process and to reduce the effect of initial friction from this source the walls are often coated with a thin film of chromium. Chromium is a hard metal which adapts itself to the plating process and forms a smooth surface on cylinder walls which is extremely durable. By means of this process the engine starts off with smooth cylinder walls which is an obvious advantage. Furthermore, the type of plating employed has a slightly porous nature which holds a good oil film and facilitates lubrication.

Q—What is a break-in oil?

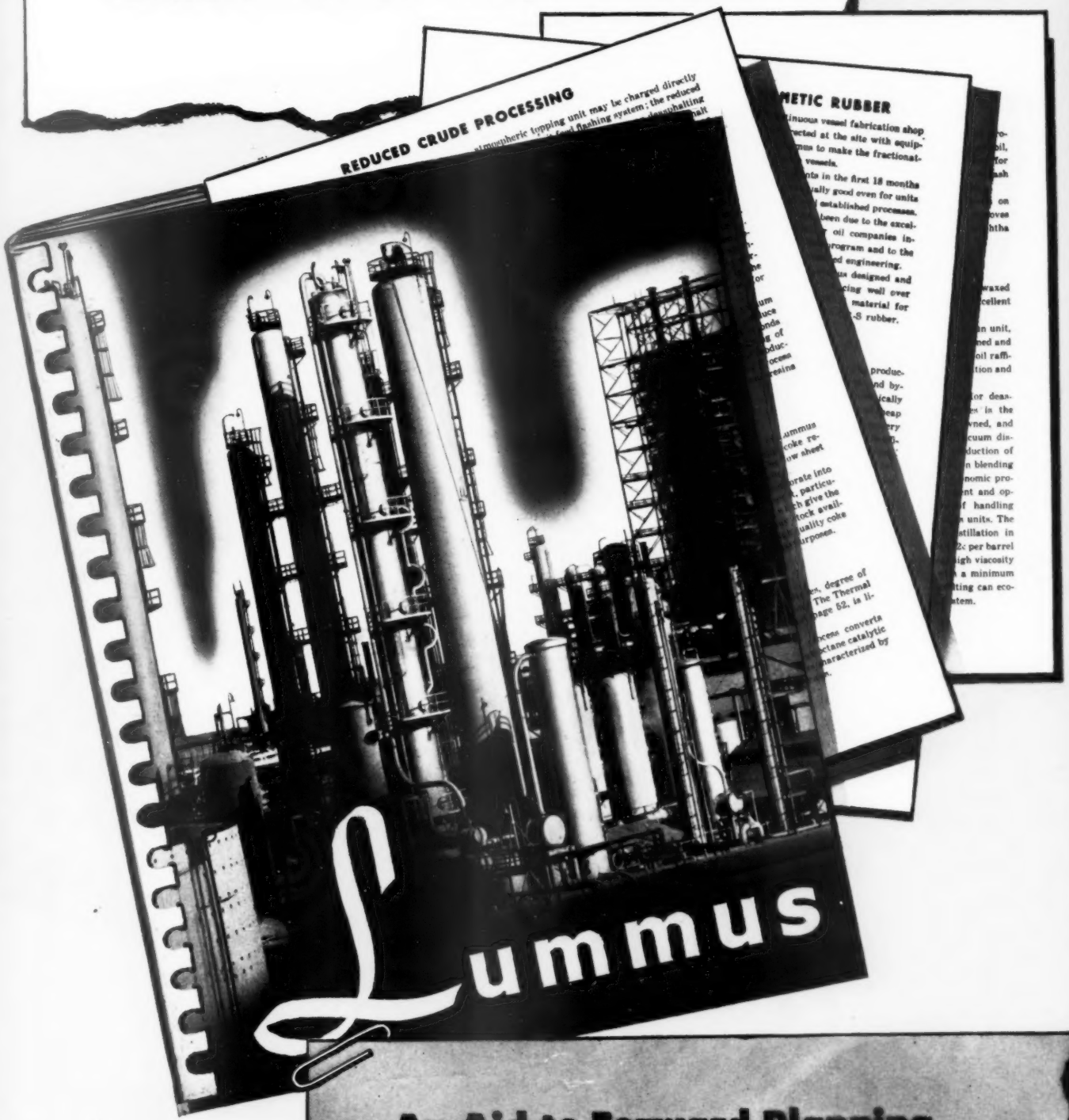
A—Engine break-in oils generally contain a small amount of extreme pressure compound such as sulfur, chlorine, or phosphorus. In the form of compounds dispersed in the oil these materials are believed to prevent welding actions between minute high spots when a new engine, or a rebored engine, is being broken-in.

Under conditions of extreme pressure such compounds react with the metal to form smooth metallic oxides which chalk off easily, but in the meantime substitute metallic film lubrication for oil film lubrication when the heat of friction becomes excessive owing to metal contact. When sulfur is used in the compound, high frictional temperatures produce iron sulfide; when chlorine is used the reactions produce iron chloride, and so on. Those reactions prevent scoring and welding of high spots, particularly between piston rings and cylinder walls.

After using a break-in oil for a period of 3 to 10 hours, the crankcase should be drained and renewed with a standard grade of engine oil. Under no circumstances should this type of oil be left in the crankcase for an indefinite period of time for the reason that unfavorable reactions are very likely to occur, accompanied by corrosion of engine parts.

The initial charge will contain metal particles, metallic soaps, etc., which makes their removal a necessity.

Just Off the Press...



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SULFONIC DERIVATIVES as LUBRICATING ADDITIVES

By George G. Pritzker

Sulfonic acids and their derivatives, recovered from the sulfuric acid treating of petroleum distillates, are widely used as improving agents for lubricating oils. The treating process can be so controlled as to give higher yields of the sulfonates of desirable properties while at the same time producing better refined oils. The sulfonates play three roles in lubricating compositions; (1) as the sole or main oil additive, (2) in combination with other additives forming a reaction product or co-acting with other additives to produce a more potent oil additive (3) acting in a subordinal manner to the chief additive as emulsifiers, non-jelling or detergent agents. Numerous patent disclosures are given of the use of petroleum sulfonates for lubricating purposes, in the three classes.

GREAT strides have been made during the past 25 years in the development of engines and machines, and the ingenuity and inventive genius of the lubricating engineer have been called upon to lubricate and maintain them successfully under the most adverse mechanical, chemical, and climatic conditions. During this short period of time the problem of lubrication has been removed from the field of kitchen chemistry and been given the most careful scientific study.

With the introduction of hypoid gears and alloy bearings, which paved the way to the development of engines capable of exerting tremendous power and speed, it became apparent that uncompounded oils, fats, and greases could never lubricate engine parts for any length of time safely and effectively.

To meet this problem there came into being oil additives which could inhibit the formation of sludge, carbon, varnish, corrosion, rusting, and bleeding, as well as impart extreme pressure, film strength, oiliness and other characteristics to mineral lubricating oils and various other lubricating compositions. Patent literature discloses hundreds, if not thousands, of inorganic and organic oil additives to meet every lubricating need.

Basically, oxygen, nitrogen, phosphorus, halogen, and sulfur-containing organic compounds constitute the bulk of the oil additives. Of these, sulfonic acids and sulfonic acid derivatives comprise a most important group of oil-improving agents. More particularly, the sulfonic acids and their derivatives obtained during the refining of petroleum distillates produce valuable oil additives. The patent literature discloses that sulfonic acids and their derivatives are used to improve every type of lubricant and meet practically every type of lubricating need.

Petroleum sulfonic acids are obtained during the sulfuric acid refining of petroleum distillates and are recovered from the oil as well as from the sludge acids.

Only a few years ago, sludge acids from which petroleum sulfonates were obtained were considered waste products which caused a considerable disposal problem. The sludge, when dumped into rivers or open fields killed marine and vegetable life and also was a health hazard. Attempts to burn it as a fuel proved unsuccessful because of its corrosiveness.

Today, this sludge is a source of valuable commercial products, the water-soluble and oil-soluble sulfonates, and is used as a protective agent for wool, silk, rayon, cotton, linen and similar fibres. The sulfonates are also used as emulsifying, detergent, and cleaning agents, stabilizers for emulsions, insecticides, inhibitors in H_2SO_4 pickling baths, dry-cleaning fluids, wood preservatives, tanning compounds, and are employed in the manufacture of varnishes. Most important of all, sulfonates are valuable lubricating improving agents: they impart extreme pressure, prevent corrosion and formation of carbon, sludge, and varnish, act as detergents, emulsifying and stabilizing agents, and perform various other desirable lubricating functions which will be indicated later.

Petroff[1] was one of the first to undertake seriously the recovery and utilization of sulfonic acids from acid sludge. Since then, the recovery of both oil-soluble sulfonic acids, known as mahogany acids, and water-soluble sulfonic acids, known as green acids, has been perfected to a fine art.

The conventional method of recovering sulphonates as by-products during the refining of petroleum distillates is to dilute the sludge with a hydrocarbon oil. The mahogany acids remain in the resulting oil layer and are separated from the sludge layer which contains the green acids. The oil layer can be washed with aqueous alcoholic solution, which removes the mahogany acids; or it can be treated with alkali and the sulfonic acids recovered with alcohol as mahogany salts. The sludge can be boiled with water and the dilute acid removed. The supernatant layer is then neutralized and the residual oil extracted with naphtha. The neutralized sulfonate is purified by washing with acid or extracting with alcohol.

Because of the ever increasing importance of petroleum sulfonates, not only in the lubricating art but in hundreds of other fields, special emphasis is placed on certain controlling factors in processing which not only produce better refined oils but have the added advantage that the sulfonates recovered as by-products possess certain definite desirable properties, and that greater yields are obtained. Thus, the type of oil, the amount, strength, and number of dumps or increments of acid used, as well as the temperature and time of contact are only some of the factors which play a vital role in producing sulphonates possessing definite, desirable properties.

For example, Adams[2] discloses that for producing improved petroleum sulfonates, the oil fraction should be from 70-500 sec. Saybolt Universal at 100° F and treated with from 6-9 lbs. of concentrated H_2SO_4 per gal. of oil. The oil is treated in half pound increments and the sludge removed after each increment. The acid-treated oil, containing oil-soluble sulfonic acids, is neutralized with sodium hydroxide. The sodium sulfonate is extracted with alcohol and recovered from the alcohol by evaporation. Salts of K, Ba, Ca, Sn, Pb, Al, Cr, Co, and Ni sulfonates are produced by conventional means, and possess outstanding corrosion inhibiting

Mr. George G. Pritzker is U. S. Patent Examiner, Division 64 of the U. S. Patent Office, Richmond, Va.

properties for metal surfaces.

Although so far only sulfonic acids derived from petroleum distillates have been mentioned, other types of sulfonates have proved to be valuable additives for lubricating compositions, among them being sulfonation derivatives of animal, vegetable and marine oils, as well as aliphatic and aromatic sulfonation products derived from various synthetic organic compounds.

In outlining the role of sulfonates in lubricating compositions, three subclasses or groups will be indicated. The first will relate to sulfonates as the sole or main oil additive. The second will deal with sulfonates in combination with other additives, these sulfonates forming a reaction product or co-acting with other additives in order to produce a more potent oil additive. The third group will deal with sulfonates which act in a subordinal manner to the chief oil additive as emulsifiers, non-jelling, or detergent agents.

One of the earliest disclosures of the use of petroleum sulfonates for lubricating purposes is in the Maitland patents,[3] in which petroleum sulfonates are used as substitution products for soaps in the manufacture of greases, cutting oils, etc. Johnson,[4] preparing a lubricant for use in the presence of water, dispersed water-soluble sulfonic compounds (green acids) in an oleaginous vehicle such as corn oil, sulfurized corn oil, lard oil, soya bean oil, or oleic acid, and added the mixture to mineral oil. An illustrative example is:

10% sodium water-soluble sulfonate
5% oleic acid
85% mineral oil
3-5% rosin oil

Isoprophyl or ethyl alcohol could be added, to form a more stable emulsion.

Another Johnson patent[5] used a composition for die lubrication comprising 5 parts tallow, 75 parts water, and 20 parts green sulfonates.

A stable lubricating emulsion was obtained by DeCew[6] by mixing sulfonated oils, such as sulfonated corn oil or castor oil, with mineral oil or vegetable oil and then dispersing the mixture in water.

Howes[7] discovered that when about 2.5% sulfonated oils, such as sulfonated corn, cottonseed, turkey red oil are added to petroleum oils they reduce the surface tension of lubricating oils by decreasing the globule size of the oil so as to overcome cohesion, thus producing a better lubricant.

Stamberg,[8] in preparing a drawing lubricant, utilized alkali or ammonium salts of green acid sulfonates and fatty oils such as tallow and lard. A typical composition comprised:

1-20% green acid soap
1-50% colloidal clay
1-50% mineral oil
1-50% water

A small amount of pine oil was added as a deodorant.

Adams,[9] in preparing a drawing lubricant, used a composition very similar to Stamberg's except that oil-soluble sulfonates were employed as the emulsifying agent. Adams' drawing composition comprised:

1-30% animal fat
1-50% colloidal clay
2-20% mineral oil
2-20% mahogany soap (emulsifying agent)
1-75% water.

Pine oil was used here also as a deodorant.

Averson,[10] in order to improve heavy oils and greases suitable for lubricating gears and bearings wherein heavy loads are encountered, added to the lubricant 5-30% heavy metal salts of petroleum sulfonic acid. The preferred heavy metals were Pb, Cu, Zn, and Fe. The lubricant prevented seizure of bearing under severe loads, as well as pitting and scoring. Another Averson patent[11] discloses the use of 1-20% Pb mahogany soap added to a lubricating oil.

Tietig[12] added from 0.10-5.0% of a heavy metal salt of petroleum sulfonic acid to lubricants for internal combustion engines. The preferred salts were Pb, Sn, Cu, Zn, Cd, Hg; and the sulfonic acids were paraffin sulfonic acids, olefine sulfonic acid, naphthalene sulfonic acid. The heavy metal sulfonates formed heavy metal oxides on the protected surface, which prevented scoring and reduced friction.

Jaeger,[13] in producing esters of sulfosaturated and unsaturated aliphatic dicarboxylic acids such as disulfosuccinic acid and its salts, discovered that they possess the property of improving lubricants suitable for metal cutting. Buc[14] has formed lubricating emulsions of mineral oil, castor oil, cottonseed oil, whale oil, and their mixtures with mahogany soap. These combinations when used alone or in conjunction with ammonium or triethanolamine oleate, linoleate, naphthenate, water-soluble sulfonates, and a minor amount, 0.2-2%, of stearic, palmitic, or arachidic acid to prevent foaming of the emulsion, produced an excellent lubricant.

Lazar[15] added from 0.01-1% lime or Mg soaps of sulfonic acid, oleic, stearic, or naphthenic acids to stabilize lubricating oil subjected to high temperature and pressure, as encountered in cylinders of steam engines. Murphy[16] added 0.05-5% alkali metal mahogany sulfonates to lubricating oil in order to inhibit corrosion. Non-corrosive lubricants were also obtained by adding to a lubricating oil[17] Co, Cd, or Sn mahogany sulfonates.

Sachanen[18] disclosed that mineral oil sulfonic acid bodies derived from cracked products of higher lubricating products than gasoline inhibit oxidation of hydrocarbon oils.

Excellent metal working lubricants for forming, processing, handling, and finishing of metals are disclosed by Freeman,[19] and comprise adding sulfonic acids and salts of both aliphatic and aromatic hydrocarbon derivatives to various lubricating mediums, such as oil or water. A few of the sulfo derivates used are hexane sulfonic acid, amyl sulfonic acid, monochloramyl sulfonic acid, benzene sulfonic acid, phenol sulfonic acid, naphthalene sulfonic acid, heptane sulfonic acid, acetone disulfonic acid, dichloramylene sulfonic acid, myristic sulfonic acid, stearic sulfonic acid, anthracene sulfonic acid, the sulfonic chlorides, disulfonic dinaphthyl methane, tristearin sulfonic acid, amylum sulfonic acid, and spermaciti sulfonic acid.

Brandt[20] sulfonated mineral oil extract and neutralized it with Na, K, amines, alkylolamines, ammonium, Ca, and used the neutralized sulfonated petroleum extract product as a lubricating oil additive. An example of a Brandt lubricating composition is:

5% ammonium salt of sulfonated mineral oil extract
5% triethanol amine oleate
90% liquid petroleum
Water added as desired.

Olin[21] disclosed that extreme pressure lubricants for auto engines, transmissions, and metal working were obtained by adding to a lubricant from 0.1-5% of ammonium salts of organic and inorganic acids such as tributylammonium p-toluene sulfonate and tributylammonium 2-5 dichlorbenzene sulfonate. Lazar[22] employed Ca, Sr, Br, Mg sulfonate, naphthenate, oleate, or their mixtures for steam cylinder lubrication. To prevent oxidation and sludge formation in engines operating under high temperature and pressure, as well as to prevent ring sticking, from 0.5-5% Al sulfonate[23] derived from sulfonic acids obtained in the H_2SO_4 treatment of lubricating oils was added to a lubricating oil. To prevent discoloration of such lubricants, tributyl phosphite, aliphatic polyamines or metallic alcoholates can be added in minor amounts.

Lazar[24] disclosed that Ca, Sr, Ba, and Mg salts of sulfonic acids derived from animal, vegetable, fish, hydrogenated fish oils and organic acids, when combined with lubricants, inhibit corrosion as well as improve metal affinity, and penetrating and spreading properties. In addition, such products do not tend to thicken with increased temperature, nor do they tend to decompose.

A new lubricating additive is disclosed in the Waldo patent,[25] in which sulfonated solvent tar products obtained from solvent treatment of lubricating oil are used as detergent and cutting oil improving agents when combined with rosin soaps.

Waugh[26] discloses that salts of esters of sulfocarboxylic acids, such as calcium salts of dioctyl esters of sulfosuccinic acid, when added to lubricants, inhibit corrosion. Good cutting oils are produced by the addition of a

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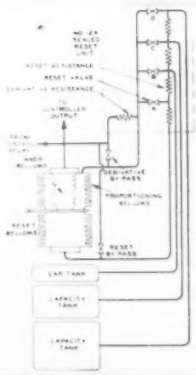

Why HYPER-RESET Requires Only 1 Adjustment

An exclusive practical advantage of the HYPER-RESET Stabilog Controller is its simplicity of manipulation. The patented HYPER-RESET feature provides simultaneous setting of both the reset and rate-sensing functions.

A definite pressure drop across the derivative resistance for every rate of change in the measuring system produces an extra increment of correction.

Only one adjustment is necessary because each reset adjustment valve connects the derivative resistance to a different capacity in the network. (See diagram at left.) Since the proportioning system is automatically self-balancing, the use of a derivative resistance requires a greater quantity of air to maintain equilibrium. In producing this greater flow, a different pressure drop is established by each adjustment. Hence, the effective value of the fixed derivative resistance is really dependent upon the capacity in series with it – and requires no independent adjustment.

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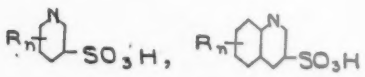
minor amount of sulfurized vegetable oil, such as sulfurized wood fatty acids.

The method of neutralizing petroleum sulfonic acids with dry $Ca(OH)_2$ to produce calcium sulfonates suitable for use in internal combustion engines is disclosed by Higbee.[27]

In order to obtain an improved cutting oil emulsion additive Morgan[28] treated a Duvall crude oil with chlorine in the presence of a catalyst and a reactive inorganic halide, and then treated the intermediate reaction product with chlorosulfonic acid, and finally neutralized it with an alkali.

Larson[29] found that sulfonates having a general formula:



are excellent additives for lubricating compositions.

The synergistic effect of organic sulfo derivatives with other organic oil additives is illustrated by Doell,[30] who found that mixtures of metallic salts of unsaturated acids and sulfonic acids stabilized lubricating oils in storage, prevent sticking and gumming of pistons, and also prevent wear and chattering of internal combustion engine parts. Such mixtures usually comprise 0.1-3% metallic salts of oleic-sulfonic acid mixtures. The preferred fatty acid salts are Pb oleate, linoleate, and ricinoleate, and the Na, Al, Cu, Ca, and Pb sulfonates.

In order to form a non-foaming cutting emulsion, Hoel[31] mixed sulfonated sperm oil with mineral oil and emulsified the mixture with the aid of rosin, fatty acids, or sulfonated vegetable or animal oils.

Wilken[32] compounded a drawing lubricant of the following materials:

1-30% animal fat (tallow)
8-40% sulfonated or naphthenic soap
8-60% mineral oil
5-20% rosin or fatty acid soap
0-15% alcohol

An anhydrous, non-corrosive, extreme pressure lubricant for plug valves and steam lines which would not be affected by hot steam or aqueous liquid was compounded by Brunstrum,[33] and consisted of the following materials:

35-65% amorphous graphite
2-15% anhydrous lime soap
15-45% Pb mahogany soap

Adams[34] mixed in definite proportions a mahogany soap and sodium rosin soap to form an excellent soluble cutting oil. The general formula consisted of:

12% mahogany soap
1-6% rosin soap
2.5-5% water

Alcohol was used as a solvent, if desired.

A soluble cutting composition was compounded by Hermann;[35] it consisted essentially of 10-50% emulsifying base and 5-25% of a non-corrosive base, and 85-25% mineral oil. The emulsifying bases were made up of sulfonated mineral oil, soda soap of oleic acid, rosin, and free oleic acid. The non-corrosive base consisted of 10% sulfurized compounds, such as sulfurized oleic, stearic acids, sulfurized whale oil, soya bean oil, mineral oil, or terpenes.

Morway[36] disclosed that a lubricant containing 3 moles Pb and 1 mole Zn salts of oleic or stearic acids and mixtures of these such as may be obtained from tallow and natural fats is greatly improved by the addition of 2-5% sulfonic acid. Minor amounts (0.3-1%) of sulfurized compounds, such as mercaptans, polysulfides, sulfurized olefines, mineral oil, vegetable and marine oils, as well as sulfurized terpenes and pine oil, impart to the lubricant extreme pressure properties such as are encountered in auto transmissions and hypoid gears.

The use of Pb sulfonate and naphthenate (5-15% and preferably 2-3%) in combination with ½-5% sulfurized animal, vegetable, or marine oil, in which sulfur is in corrosive form in order to produce an extreme pressure lubricant is disclosed by Miller.[37] Another extreme pressure lubricant adapted for transmission service[38] uses a mixture of Pb oleate, stearate, or other fatty acids, and Pb sulfonate or naphthenate.

The Cannon patent[39] is one of the first to disclose the reactivity of sulfonates with other organic compounds to obtain an improved oil additive. To produce this product, Cannon treated sulfonates with urea and found that the product prevented corrosion of Cd alloy and Cu-Pb bearings and was excellent for use in transformers, cables, and insulating oils.

A corrosion preventive lubricant for metal surfaces comprised alkali sulfonate and degras.[40] Further to enhance corrosion-inhibiting properties of compositions like these, fillers such as chromates, silicates, and alkaline materials, as well as sodium nitrite, borax, and amines were used.

In order to obtain a lubricating base resistant to oxidation and possessing antiringsticking properties, Bergstrom[41] reacted an organic acid with metal oxides or hydroxides in the presence of aqueous ammonium. The acid used was oil-soluble sulfonic acid, such as mahogany sulfonic acid, and the metals were Na, Li, K, Cu, Zn, Cd, Al, Ar, Sb, Bi, Cr, Co, Mo, W, Mn, Fe, Co, and Ni.

Zimmer[42] disclosed that by mixing one part of a naphthenate with four parts sulfonate and then adding waxes of acids having 22 carbon atoms or more containing 5-50% free acid, such as montan wax, a non-foaming cutting oil emulsion base is formed. Another lubricating and cutting composition for metal working was obtained by Singer[43] by combining higher molecular weight fatty acids with aliphatic, cycloaliphatic and aromatic, oxy- and halogen sulfonates. The general structure of such compounds is:

$$RCOOR_1SO_3X$$

wherein R is an aliphatic radical and X is Na or K. Other addition agents which could be incorporated with the composition are alkali carbonates, borax, rapeseed oil, and rape oil. Another cutting oil emulsion base comprised:[44]

5-18% chlorinated mahogany sulfonate soap
0-3.5% sodium rosin
1.5% alcohol
1% water
79.5-89% oil

The chlorinated sulfonate, in addition to acting as a lubricant, is utilized as a bactériostatic agent, and in an oil medium appears to be more potent than phenolic materials as a germicidal agent.

Rapeseed soap[45] or rosin soap is utilized as a chief constituent for a wide temperature lubricant in combination with a minor amount of sulfonate. Bergstrom[46] discloses that Cd, Co, Ni, Mg, Ca, Sr, Ba, Al, and Zn petroleum sulfonates in combination with anti-oxidants of the phenolic or aryl amine type, such as naphthols, phenols, alkylated catchol, and naphthylamines, prevent ring sticking and corrosion. In addition, salts of fatty, aromatic fatty, naphthenic and rosin acids can be used. In order to increase E.P. properties, there are added sulfurized cottonseed, soya bean, perilla, tung, sunflower, and sperm oils, as well as sulfurized olefines, sulfurized dihydronaphthalene polymers, aromatic sulfides, chlorinated wax, chlorinated terpenes, chlorinated fatty acid esters, sulfur chloride treated fatty oils and hydrocarbons, phosphites and phosphates, phosphorus sulfide treated fatty oils or acids.

Waugh[47] found that alkali-alkaline earth salts of esters of sulfo dicarboxylic acid stabilize and solubilize oil-soap mixtures suitable for internal combustion engine lubrication, and that they prevent corrosion. A typical composition consists of calcium naphthenate and sodium dioctyl sulfosuccinate. A lubricant to facilitate mounting pneumatic tires[48] is comprised of potato starch, with potassium sulfonated castor oil, sodium lauryl sulfonate, oleyl sulfonate, and diglycol oleate.

In order to modify oils of various viscosity so that they remain non-fluid or plastic with various temperature changes and still retain all desirable lubricating properties, Freeman[49] reacted an organic nitrogen base with an organic acid and reacted this intermediate product with an organic sulfonate. The sulfonates used to form the final complex reaction product were esters of sulfodicarboxylic acids, polyhydrated naphthalene sulfonate, and polyalkylated naphthalene sulfonate-formaldehyde condensation product, petroleum sulfonate, and sulfonated castor oil.

An effective lubricant in the presence of steam[50] comprises petroleum resins and a dispersing agent such as alkali, alkaline earth amino base salts of organic acids such as aliphatic or alicyclic

sulfonic acids, and, more particularly, fatty sulfonic acids and fatty aromatic sulfonic acids. In the presence of steam, fatty acids such as tallow should be avoided, as they tend to decompose and cause corrosion. A non-corrosive[51] pour point depressing additive, which is stable in storage, comprises the addition of Na, K, Mg, Zn, Ni, Co, Cd, Sn, Cr, or Al petroleum sulfonate to Sn, Ca, Mg, or Al stearate in the ratio of stearate to sulfonate of 10:1 to 2:1. The combination also prevents jelling of the soap. Stiegler[52] sulfonated tallow and stabilized the product by the addition of a reaction product of metal bisulfite with formaldehyde.

A cutting oil was obtained by Carlson[53] by mixing one part naphthenate, four parts sulfonate, and amine soap. To cause separation of chips, phenolic derivatives such as xylenols, cresols, and petroleum phenols are added to the emulsion.

Neely[54] discloses that combination of various salts of different organic acids prevents formation of adhesive oxidation produced at elevated temperatures. Suitable acid mixtures are stearate-sulfonate, naphthenate-sulfonate, benzoate-sulfonate, phenate-sulfonate, phosphate-sulfonate; the salts used were Al, Ca, Ba, Sn, Zn, Mg, Co, Cd, Mg, and Cr. Sulfonated mixtures[55] or organic sulfonates alone and then mixed, produce excellent drawing lubricating compositions, as disclosed by Nill.[55] The sulfonated mixtures were fatty acids, resinous acids, and alcohols. The mixtures consisted of two or more parts of fatty acids, such as stearic, palmitic, lauric, oleic, and one part of rosin acid, such as abietic acid and tall oil or alcohols, such as stearyl alcohol, oleyl alcohol, or lauryl alcohol. A typical mixture is comprised of sulfonated sperm oil and tall oil, which was then neutralized.

Sulfurized type oils,[56] chlornaphthaxanthate type E.P. base or chloraliphatic thiocarbonate E.P. base are added to heavy metal soaps of naphthenate, sulfonate, oleate, or stearate to improve their lubricating properties.

Liberthson,[57] by compounding carefully the following ingredients, obtained a transparent lubricating emulsion:

31-40% mahogany sulfonate
15-20% surface tension depressant, such as alkali salts of unsaturated aliphatic acids (alkali oleates, linoleates, ricinoleates)
25-30% water
12.5-17.5% homogenizing agent consisting of a mixture of glycol ether, glycerine, and diethylene glycol

Zimmer[58] found that by adding candelilla wax to compositions consisting of mahogany soap, naphthenate, and alcohol, an improved lubricant is formed.

Various organic derivatives of inorganic oxyacids are disclosed by Knutson[59] as lubricating oil additives. Sulfuric acid derivatives which form sulfo-organic compounds are benzene sulfonic acid, p-phenyl benzene sulfonic acid, 1-amino 8-naphthol sulfonic acid, 2-naphthol acid, p-toluene sulfonic acid, benzene sodium sulfonate, sodium p-naphthol disulfonate (2-6-8), and ethyl benzene sulfonate.

A bullet lubricant[60] made up of waxes, sulfonated castor oil, fatty alcohols, or naphthalenes, a film strength agent, such as cellulose derivative, and protective colloids of casein, glue, and natural resins in order to stabilize the emulsion, is disclosed in the Dew patent.[60]

The reaction product of P_2S_5 and petroleum sulfonate is disclosed in the Faust[61] and Cook[62] patents, which utilize this reaction product in engine lubrication and for the protection of metal surfaces against corrosion. Zimmer[63] found that when amine-sulfonated oil mixtures, such as sulfonated oleic acid, are reacted with aniline or dicyclohexylamine, they prevent foaming of lubricants containing E.P. agents such as Pb oleate, naphthenate, sulfonates of Ca, Ba, Mg, Zn, Sn, Cu soaps, or chlorinated paraffin wax, chlorinated kerosene, sulfurized lard oil, sperm oil, mineral oil, isobutylene polymer, Sn wax sulfosalicylate, or such oxidation inhibitors as alkylphenols and sulfides and sulfur chloride reaction of alkylhydroxy aromatic hydrocarbon.

The chlorination, phosphorization, sulfonation, and neutralization of a mineral oil admixed with diglycol laurate, oleic acid, and triethanolamine, as disclosed in the Morgan patent,[64] forms cutting oil emulsions. The combination of an oil-soluble detergent and an oil-soluble anti-corrosion agent in order to obtain an excellent lubricant is disclosed in the Wilson patent.[65] The detergents used were oil-soluble metal soaps of synthetic acids derived from oxidized petroleum products or oil-soluble metal soaps of sulfuric acids or Al, Cu naphthenates. The anti-corrosion agent is an alcohol-phenol condensation product of stearyl alcohol-phenol condensation in the presence of H_2SO_4 as a catalyst and its salts. In order to produce an oil additive, the reaction mixture of salts of petroleum sulfonic acids and salts of alkyl substituted phenol sulfides or salts of alkylated phenolic thioethers and alizarin, quinizarin, and anthragallol is disclosed in the Jenkins patent.[66] The salts used in these reactions were Ma, K, Ca, Ba, Sr, Mg, Al, Zn, Cu, Pb, Ni, Co, Mn, Cr, Sn, and Fe.

Towne[67] disclosed that polyvalent metal salts of petroleum sulfonate and phosphatidic materials form good lubricating oil addition agents.

To improve the lubricating properties of sulfonates, the sulfonates are subjected to an oxidation treatment with $KMnO_4$[68] in order to remove or convert the corrosive constituents present in the sulfonates. The oxidized product, according to Ruedrich,[68] is a marked improvement over a non-oxidized sulfonate. Lubricants which prevent corrosion, ring sticking, wear, sludge, and varnish in combustion and diesel engines are obtained by Mixon[69] by reacting polymers with chlorsulfonic acid and neutralizing the reaction product. This material can be reacted further with sulfur and/or phosphorus-containing compounds such as S_2Cl_2, SCl_2, P_2S_5, P_2S_3, P_4S_7, PCl_3, PCl_5, and P_2O_5.

In addition to the important functions sulfonates perform in lubricating mediums either per se or when mixed or coreacted with other organic oil improving agents, they are also used as subordinal additions to the main lubricating additive, functioning as emulsifiers, detergents, stabilizers, etc.

Thus, mahogany sulfonate[70] acts as an emulsifier for a drawing lubricant comprising:

5-18% tallow
20-40% alkali soap of oxidized hydrocarbon oils

In order to form a stable cutting oil or lubricating composition containing 1-15% ammonium oleate,[71] sulfonated or phenolated cottonseed, soy bean, rapeseed, olive, coconut, or corn oil is used as an emulsifier. An emulsion for cold-working containing sulfonated castor oil soap, glycerine, and an aqueous solution of dipotassium phosphate, monosodium phosphate, and monoammonium phosphate is disclosed in the Tufts patent.[72] Petroleum sulfonate[73] is used as an emulsifier in a cutting oil emulsion consisting of hydrogenated mineral oil, triethanolamine oleate, and mahogany sulfonate. Alkali metals of fatty acids, rosin acids, sulfonic acids, and naphthenic acids are used as emulsifiers[74] for animal, vegetable, and mineral oils. To stabilize such emulsions further, pine oil, oxygenated terpene, terpineol, borneol, fenchyl alcohol, camphor, or their mixtures, are added.

Fabian[75] disclosed that a cutting emulsion of mahogany sulfonate, sodium rosin soap, alcohol, water, and mineral oil is stabilized against bacteria by the addition of tetrachlorphenol, phenyl phenol, chlorinated phenyl phenol, or their salts. Zimmer[76] discovered that greases can be prevented from bleeding by adding amorphous hydrocarbon waxes, such as petrolatum and ceresin, to the grease; and, in order to solubilize the waxes in the grease, alkali and alkaline earth alkyl and aryl sulfonated alcohols, or naphthenic acids were used. A sample of such a grease comprised:

12% Ca soap of horse fat
1% Na mahogany sulfonate
20% petrolatum
2% water
65% mineral oil

To another lubricating composition, Zimmer[77] added esters of furoic or pyromucic acids. An example of such a composition consisted of:

69½% red machine oil
10 % petrolatum wax
15 % lime soap
2 % Ca soap,
1 % butyl furoate
½-1% water
1½% glycerine

Mahogany sulfonate[78] is also used as an emulsifier for cutting oil emulsions containing sulfurized fatty oils which impart film strength and high lubricity or oiliness to the composition. Lead oleate,[79] sulfonate, or naphthenate is used as an assisting agent for lubricants containing sulfur in reactive form in order to impart E.P. properties to the lubricant. The compounds sulfurized were lard, pine, and fish oils.

In high speed cold rolling of strip steel lubricated by petrolatum, palm oil and sulfurized sperm oil or chlorinated petroleum fraction of medium viscosity, sulfonic acid soaps[80] are used to assist in the removal of the material from the finished stock. Flett[81] discloses that sulfonic acids are excellent emulsifiers.

Sulfonated fatty oils[82] sulfo-aromatic compounds of fatty oils, such as Twitchell reagent and naphthenic or sulfonaphthenic acid soaps, are used as solubilizing agents for vegetable, animal, or marine fats or oils which have been first sulfurized and then phosphorized in order to produce a cutting oil additive. Mahogany soap,[83] sulfonated olive, sperm, cottonseed, and fish oils can be used as emulsifiers for cutting emulsions comprising water-insoluble soaps of naphthenic and unsaturated fatty acids such as Zn, Pb, Al, Cu, Cr naphthenate and oleate.

In order to obtain sulfurized fatty oils containing 10-20% sulfur in stable, odorless form suitable as an oil additive, Zimmer[84] sulfurized a solvent extraction product of petroleum and further improved the product by adding lead sulfonate and naphthenate. Such a lubricant was stable in storage and useful for hypoid gears, cutting, drawing, and stamping. In order to increase the cutting efficiency and prevent rusting, Nelson[85] added sulfonated castor oil to an emulsion containing equal parts of sodium resinate and naphthenate. Sulfonated oils are disclosed by Ott[86] as dispersing agents for lubricants and coolants for machining metals containing alkylolamine esters of higher fatty acids.

Lincoln[87] lists a large number of salts or soaps of sulfur bearing acids capable of carrying heavy loads in lubricating compositions. Among the sulfo compounds used are diphenyl antimony benzene sulfonate, benzene sulfonic acid, tri-isopropyl naphthalene sulfonate, chlornaphthalene sulfonic acid, and amyl sulfonic acid.

Asseff[88] discloses a complex reaction product of a zinc salt of P_2S_5-cyclo aliphatic alcohols as E.P. agents. In conjunction with this reaction product various detergents, among them Ca, Ba, Cr, Na, and Co mahogany sulfonate were used.

To prevent foaming of lubricating emulsions stabilized with sulfonates, Carlson[89] added minor amounts of sodium, potassium, or zinc aluminates, plumbites, or stannates to the lubricating composition.

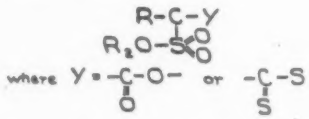
A plug valve and packing lubricant consisting of the following essential ingredients is disclosed by Ballard:[90]

80-94.75% glycerine
0.25-10% tergital (Na sec.-alcohol sulfate) of tensol (Na salt of sulfonated long chain aliphatic alcohol)
5-10% NaOH

Van Ess in his patents[91] discloses that thioxins and alpha naphthyl ethers are excellent lubricating oil additives which are further improved by the addition to the composition of minor amounts of Ca, Mg, Sr, Ba, Zn, Cd, Al, Sn, Pb, Cr, Mn, Fe, Ni, Co, Cu sulfonates.

Roehner[92] discloses that triethanolamine oleate is a good emulsifier in lubricating emulsions containing sulfurized vinifer palm oil reacted with P_4S_3.

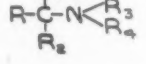
To enhance oiliness and film strength and to improve color and VI of lubricating oil, as well as to prevent sludge, varnish, and corrosion formation, Farrington[93] uses a polyvalent metal alkyl carboxylate, having a substituent with at least one atom of an element of Group VI-B of Menedelejeff's Periodic Table of Elements, near a carbonyl group of the carboxylate. The general formula of such compounds containing a sulfo radical is:



R is an alkyl radical or hydrogen.
Specific compounds are:
α, β or γ alkyl sulfo proprionic acid
α, β or γ alkyl sulfo capric acid
α, β or γ alkyl sulfo stearic acid

The preferred salts are Al, Ca, Cr, and Mg.

To prevent ring-sticking and corrosion of engines lubricated with mineral oils, White[94] aded minor amounts of alpha amino acids having a general formula of



Where R_1 to R_4 are hydrocarbon radicals.

In order to improve such lubricants further, salts of sulfonates are added as detergent agents.

Lubricating cutting oil emulsions containing alkylolamines and soaps of rosin, naphthenate, stearate, and oleate, according to Langer,[95] are emulsified with mahogany soap sulfonate and further stabilized by the addition of triethanolamine, and propanolamine.

To prevent corrosion and sludge, as well as to improve oiliness and E.P. properties of lubricants, Lincoln[96] uses many organo metallic compounds; among the sulfo compounds are listed:

Tin triamylbromo camphor sulfonate
Diphenyl chlorobismuthine disulfonic acid

To improve E.P. properties of lubricating oils, Swenson[97] formed a complex Pb soap of lead and a metal of alkali and alkaline earth group, and, in order to solubilize the complex soap product, added to such oil compositions mahogany sulfonate or naphthenate of Na, K, Ba, Al, Fe, and Pb.

Van Ess[98] discloses that thioallophanates and allophanates act as carbon softeners in lubricants susceptible to such formation, and salts of Mg, Ca, Sr, Ba, Zn, Cd, Al, Sn, Pb, Bi, Cr, Mn, Co, Ni, and organic amines of petroleum sulfonates are added to such lubricating compositions to act as detergents.

Swenson[99] uses Al, Pb, Ca, Ba, Sr, Fe, and Na sulfonates as plasticizers and solubilizers for block greases of the drawing journal type.

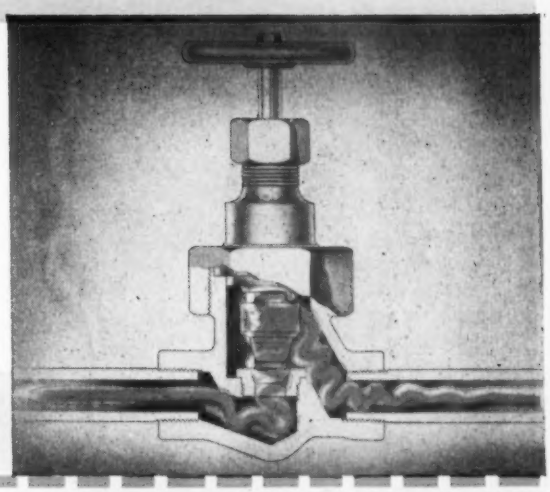
Lincoln[100] discloses that benzene sulfonic acids and naphthalene sulfonic acids when added to lubricating oils impart E.P. properties to them and prevent mechanical wear.

Nelson[101] discloses that soaps are prevented from separating out of the oil mixture by the addition of minor amounts of sodium petroleum sulfonates. Also to solubilize E.P. agents of the dithiophosphate type, such as barium dilauryl dithiophosphates in lubricating oils, the following sulfo compounds are used by Cook:[102] petroleum sulfonate, dialkyl sulfosuccinate, diisobutyl naphthalene sulfonate, diisopropyl naphthalene sulfonate, lauryl phenyl sulfonate, esters of sulfophthalic acid, lauryl B sulfo sulfbutyrate, esters of sulfo sebacic acid, capryl phenyl ester sulfonate, and sulfonated esters of talloel fatty acids. Van Ess[103] also discloses that petroleum sulfonates improve lubricants containing as the chief improving agent zinc diisopropyl salicylate.

It is important to bear in mind that oil addition agents for the most part serve only to enhance the lubricating properties of oils, and to make them more potent. The proper oil for a specific lubricating need is, however, the controlling and dominant factor in any lubricating composition. Oil improving agents serve no purpose when added to an improperly refined oil or to an oil unsuited to the specific lubricating purpose under consideration. The oil itself must be of the proper type and viscosity and as stable and chemically pure as modern chemical refining processes are capable of making it. This feature, coupled with the addition of

HOW EDWARD VALVES CUT PRESSURE LOSS, PREVENT UNDUE TURBULENCE and SAVE MONEY

PROBLEM: In an ordinary globe valve, sharp turns often cause excessive turbulence and increase pressure drop. Valve wear is accelerated, power is wasted and efficiency lowered. Years ago, Edward began research on the problem of reducing pressure drop through small forged steel valves.



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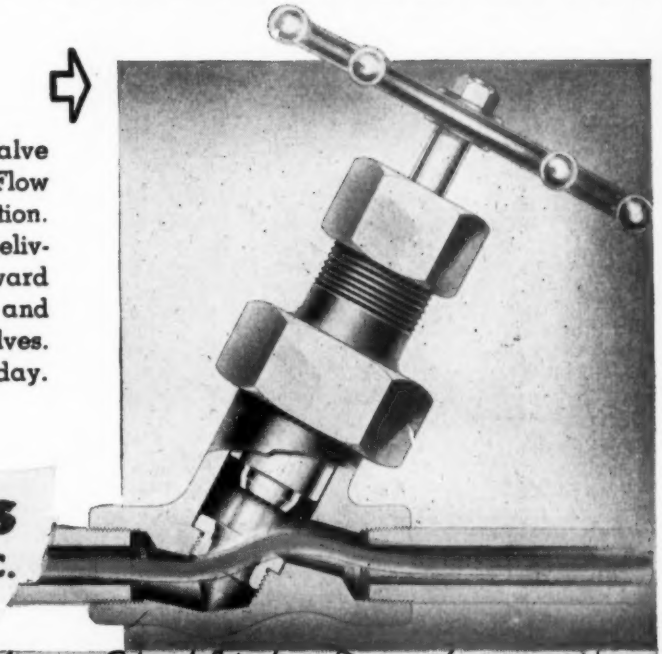

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various improving agents, such as organic sulfo compounds and their derivates discussed above, tends to produce a more potent, stable, and improved lubricating composition.

It must be remembered also that the acid test of whether an oil is improved or is capable of withstanding certain operating conditions is to subject the compounded oil repeatedly to actual operating conditions. Special tests designed to show the rust-, corrosion-, or oxidation-inhibiting properties of compounded oils, or their ability to withstand heavy loads, extreme pressures, wide temperature variations, etc., are only an indication that these compounded oils possess such properties. Under actual operating conditions the results obtained might be entirely different.

Great advances have been made in preparing lubricating compositions capable of lubricating modern engines and machines efficiently. The time is still far distant, however, when compounded lubricants will be available to meet any and every lubricating need. Much study, sweat, and research are still needed to better understand the problem of lubrication and to prepare better lubricants.

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(82) Anderson, U.S.P. 2,211,250 (40). Group III.

(83) Dombrom, U.S.P. 2,214,634 (40). Group III.

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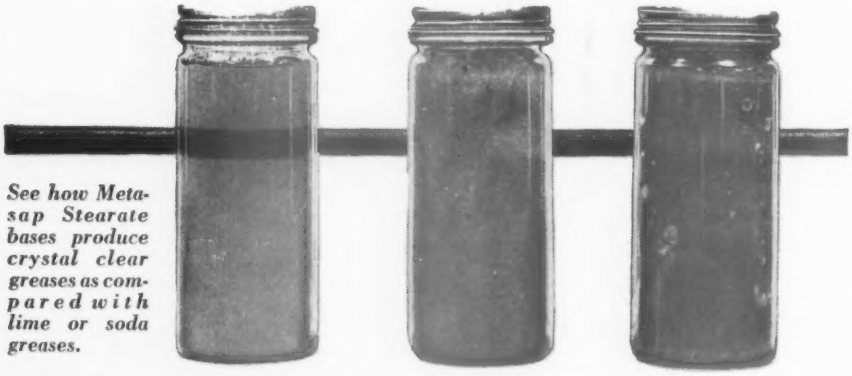

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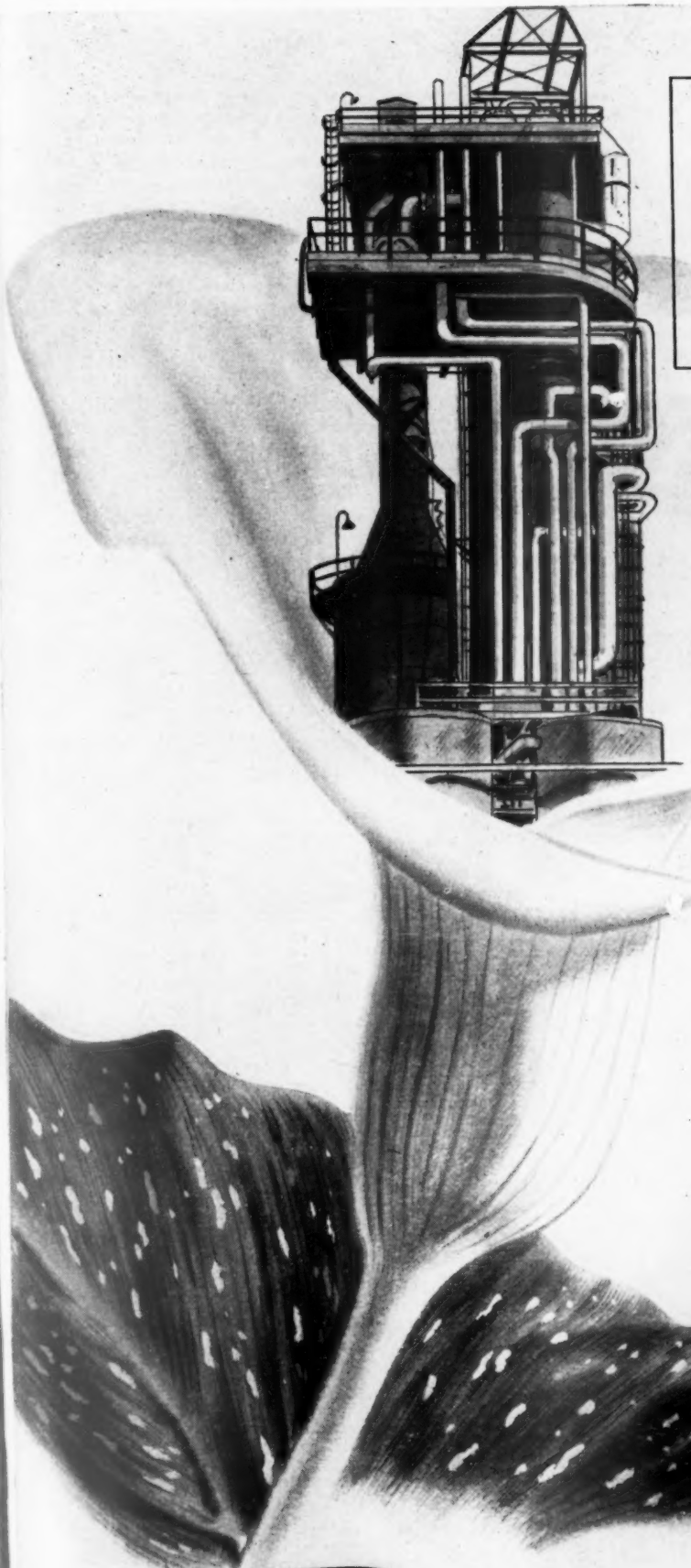

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WHITHER INDUSTRIAL RESEARCH?

By Peter J. Gaylor

AMONG the questions dealing with possible postwar industrial expansion is the important one: What will the future do to Research? There have been a number of disturbing factors which cast a cloud over the horizon. The war debts, the hard-boiled attitude of some courts on patents, taxes, and a possible business depression, all leave their imprints on industry in one way or another. Yet, a statistical review of the subject brings forth only one conclusion, and that is that *research will continue to grow at a logarithmic rate.*

In practically every instance, figures show that research expenditures of the various industrial firms, institutions and governmental establishments have been on the up-grade. From data in the literature[1] it is possible to predict (by extrapolation) roughly the rate of growth in this direction and, as can be seen from Fig. 1, the trend appears to be a doubling of research expenditure every five years.

The war has not slowed up research work. It merely deflected its course temporarily, but this has not made the results useless for peacetime industrial progress. In fact, the National Research Council[2] stated that the larger laboratories are expecting to hire three times as many scientists as they did in the prewar period.

By referring to Fig. 1 (which is based on prewar statistics), we find that, by 1946, the country's industries would be spending in the neighborhood of $500,000,000 for research. DuPont would be spending around $16,000,000, while Standard Oil Development Co. would spend around $10,000,000. The petroleum industry would be expected to spend over $40,000,000 for this thing called a "luxury" in the not-too-distant past. Like the automobile, research has moved from the luxury class to the category of a necessity. One survey has shown that research workers will make up 10% of the petroleum refining industry's personnel in 1950, if the current trend continues[3]. On the basis of extrapolation of previous expenditures[4], International Nickel can be expected to spend, in 1948, about five times the amount it spent for research in 1928.

A fair picture of where the research money (and effort) was spent in the past by the petroleum industry has been deduced from publications and patents by Winning[5]. He found that of the literature articles during 1934-6, 17% of them were on motors and motor fuels, 14% on lubricants and lubrication, 13% on cracking and isomerization, 9% on kerosine and Diesel fuels, 8% each on the subjects: asphalt, lube refining, 7% on fuel refining, and 6% on distillation and absorption. Of the patents issued during 1929-35, 32% were on refining and polymerization, 15% on cracking, 11% each on production and specialties, 9% on hydrogenation, 12% on chemicals, 6% on lubricants, and 4% on fuels.

As stated previously, this is based on prewar figures and does not take into consideration the impetus of the enormous amount of research initiated by the government for war purposes. One interesting and thought-provoking situation apparent from Fig. 1 is the position of the various countries on the chart. Although

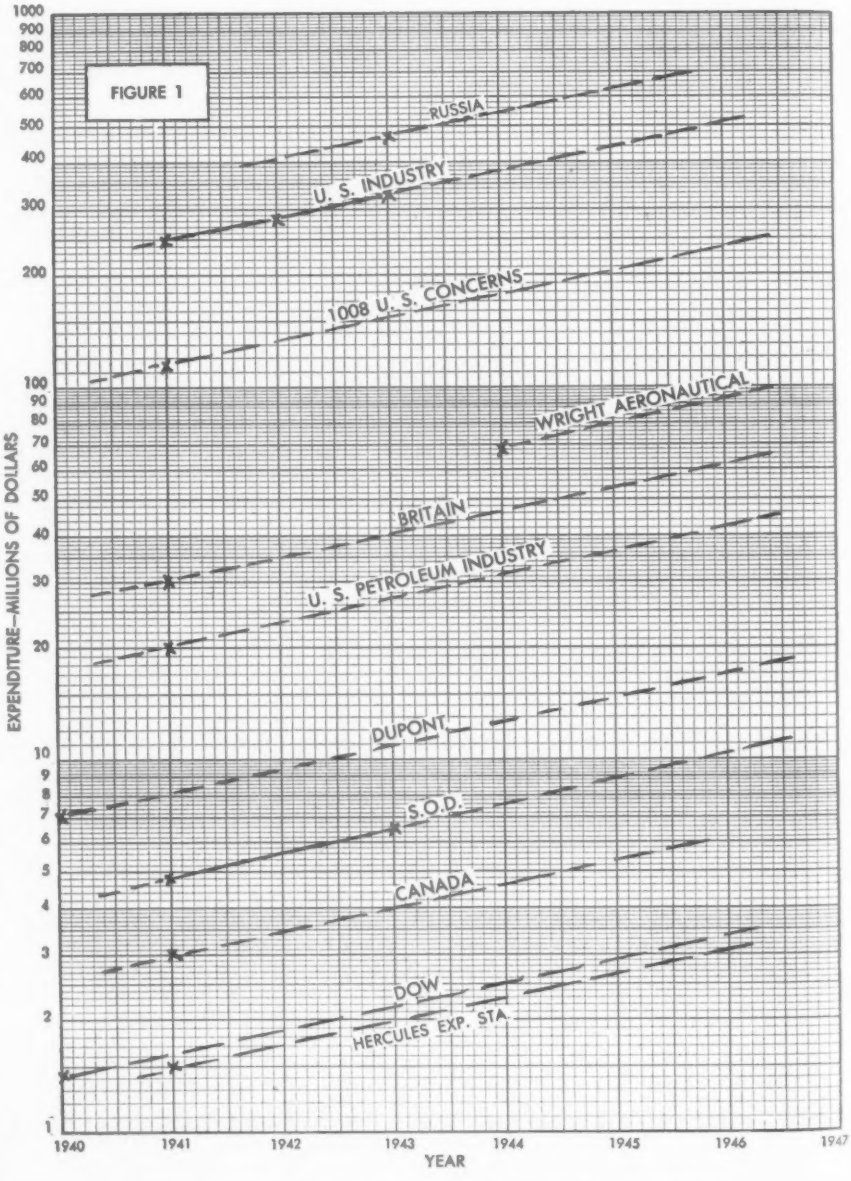

Fig. 1—Predicted rate of growth of research expenditures.

Peter J. Gaylor is editor of the weekly abstract of current technical literature—"Technical Survey". He also edits a regular column in the NPN TECHNICAL SECTION, discussing recently issued patents which have bearing on the petroleum refining industry.

Russia is spending about the same amount for research as the U. S., per capita, due to its larger population it is actually spending 50% more. The comparative figures[6] on the various expenditures are given as follows:

Country	Expenditure per capita	% of national income
Russia	$1.80-$3.00	1
United States	$2.40	0.3
Britain	$0.70	0.1
Canada	$0.22-$0.29	..

Another line of thought leading to the same conclusion is based on patent statistics. The outsider, of course, does not have access to the amount of creative work done by the various concerns in the U. S. The only reasonable criterion to him is the number of patents issued to the personnel. Naturally, there are patents and there are patents, but, on the whole, you generally must have something original to get a patent, and one would not be far from right in using it as a criterion of creative thinking, regardless of commercial significance.

Using this as a basis, a survey[7] has been made, listing the companies which have been active according to the above definition. The list, given in Table 1, is subdivided into 3 classes, viz: (1) Those companies (14 of them) obtaining more than 100 patents per year, (2) Those (32 of them) obtaining 30-100 patents per year, and (3) Those (120 in all) obtaining 10-30 patents per year. All are arranged in the order of average number of patents issued annually during the 3-year term 1941-3 inclusive. There are bound to be a few others which should be included, as well as some which are not in their proper order, since the Patent Office tabulations are not infallible and a thorough check would consume too much time. Also, other factors enter, such as secrecy orders, insufficient data on parental affiliations, size of the company's assets or capital, etc. A more representative compilation would be over a greater number of years. Nevertheless, the compilation does present a fair picture of the status of our industries in this respect, and it can be assumed that those firms not listed are not very active patent-wise.

Generally, those companies at the head of the list are the leaders in their fields. The chemical and petroleum concerns appear to be ahead of other manufacturers, particularly the metal industries, although it must be borne in mind that it is harder to make inventions in some fields than in others.

Thomas' Register (1944) lists some 25,000 manufacturers of whom more than 1700 have capitalizations of over $10,000,000, more than 5000 of over $1,000,000, and more than 10,000 of over $100,000. Now, to obtain 10 patents per year does not require an expensive creative staff. Yet, the remarkable fact brought out by this survey is that of the thousands of manufacturing institutions and businesses in this country, only 166, or less than 1%, show activity within this range, and of these, 75% of them are only mildly active. In other words, all but less than 1% of the manufacturing concerns in this country are living a hand-to-mouth existence from the technical point of view. To protect themselves from their more aggressive competitors, some of them have been complaining to the government about the evils of the patent system. In the end, of course, this will not settle their problem, for it will either eliminate technical progress in this country in favor of other more progressive nations, or it will force the government to do their research and development—a step toward socialism which they resent even more. The ultimate solution obviously lies in jumping on the bandwagon, and already many of those who do not feel able to cope with the problem alone have formed research pools[8] from which they have benefited appreciably.

Even though we may consider ourselves as the most industrially progressive nation at present, we are advancing at only a snail's pace in comparison with our potential ability in this direction.

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TABLE 1—Listing of Companies by Patents Obtained Annually

Class A (Over 100)

1. General Electric
2. Bell System
3. Westinghouse
4. duPont
5. Radio Corp. of America
6. General Motors
7. Standard Oil Development
8. Eastman Kodak
9. United Shoe Machinery
10. General Aniline
11. Dow Chemical
12. American Cyanamid
13. National Carbide & Carbon
14. Union Switch & Signal

Class B (30-100)

1. Shell Oil
2. Standard Oil (Indiana)
3. Bendix Aviation
4. Universal Oil Products
5. Celanese
6. Goodrich
7. U. S. Rubber
8. Chrysler
9. Minneapolis Honeywell
10. Texas Corp.
11. U. S. Steel
12. Socony Vacuum
13. International Harvester
14. Hercules Powder
15. Int. Business Machines
16. Phillips Petroleum
17. American Can
18. Pittsburgh Plate Glass
19. Hoover Co.
20. Wingfoot (Goodyear)
21. Monsanto
22. Allis Chalmers
23. Sylvania
24. Borg-Warner
25. American Car & Foundry
26. Firestone
27. Int. Standard Electric
28. Western Union
29. Singer Mfg.
30. Philco
31. Rohm & Haas
32. Corning Glass Work

Class C (10-30)

1. Libbey-Owens-Ford
   Pullman & Kellogg
   Servel
   Associated Electric Labs.
2. Deere & Co.
3. Electric & Musical Industries
   Edward G. Budd Mfg. Co.
   Continental Can
   Union Oil
   Aluminum Co.
4. Norton Co.
   Owens-Illinois Glass
5. Musher Foundation
   Standard Oil (Calif.)
   Industrial Patents Corp.
   Cutler-Hammer
6. United Aircraft
   Winthrop Chemical
   Remington Rand
   Hartford National Bank & Trust Co.
7. Crane Co.
   Interchemical Corp.
   Gulf Oil
8. Babcock & Wilcox
   Food Machinery Corp.
9. R. G. Le Tourneau Inc.
   Petrolite Corp.
   Sperry Gyroscope
   Wm. A. Ray
10. Alexander Boynton
    Johns Manville
    Brown Instrument
    Crampton & Knowles
    Vickers, Inc.
    Schering Corp.
11. U. S. Gypsum
    Sears Roebuck
    Owens-Corning-Fibreglas
    Gen. Railway Signal
    Hazeltine Corp.
    Crown Cork & Seal
    Ditto, Inc.
    Armstrong Cork
    Tinnerman Products Inc.
    Nash-Kelvinator
12. Geo. A. Lyon
    National Cash Register
    Sullivan Machinery
13. Underwood-Elliott Fisher
    Pure Oil
    Armour & Co.
14. Houdaille-Hershey
    Electrolux
    Bethlehem Steel
    Merck & Co.
    Goodman Mfg. Co.
    Research Corp.
15. Square D Co.
    Lane Material Co.
    General Tire & Rubber
    United-Carr Fastener
    Carborundum Co.
    Western Cartridge
    A. O. Smith Corp.
16. Koppers Co.
    Reed Roller Bit
    Scovill Mfg.
    Bell Aircraft
    Minnesota Mining & Mfg.
    National Oil Products
    Curtiss Wright
    American Steel Foundries
    Hydraulic Development Co.
    Rudolph Wurlitzer
    Air Reduction
17. Fairbanks Morse
    Clark Equipment Co.
    Ford Motor
    Murray Corp.
    Jeffrey Mfg.
    Packard Motor
    Geigy
18. Hartford Empire
    Lane Wells
    Sinclair Refining
    Stewart Warner
    Trico Products
    Farnsworth Television & Radio
    Wagner Electric
    National Lead
    Thos. A. Edison, Inc.
    Cities Service
    Hemphill Corp.
    Talon, Inc.
    International Nickel
    Raytheon
    American Brake Shoe & Foundry
19. Ohio Brass
    Houdry
    Ciba
    Int. Cigar Machinery
    Tidewater
    Solvay Process
    Bausch & Lomb
    Dorr Co.
    North American Rayon
    Glenn L. Martin
    Atlantic Refining
    Commercial Solvents
    Colgate-Palmolive-Peet
    Briggs Mfg.
20. Chicago Pneumatic Tool
    Otis Elevator
    Timken Roller Bearing
    Eaton Co.
    B. F. Sturtevant
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    Lummus
    Knapp Monarch Co.

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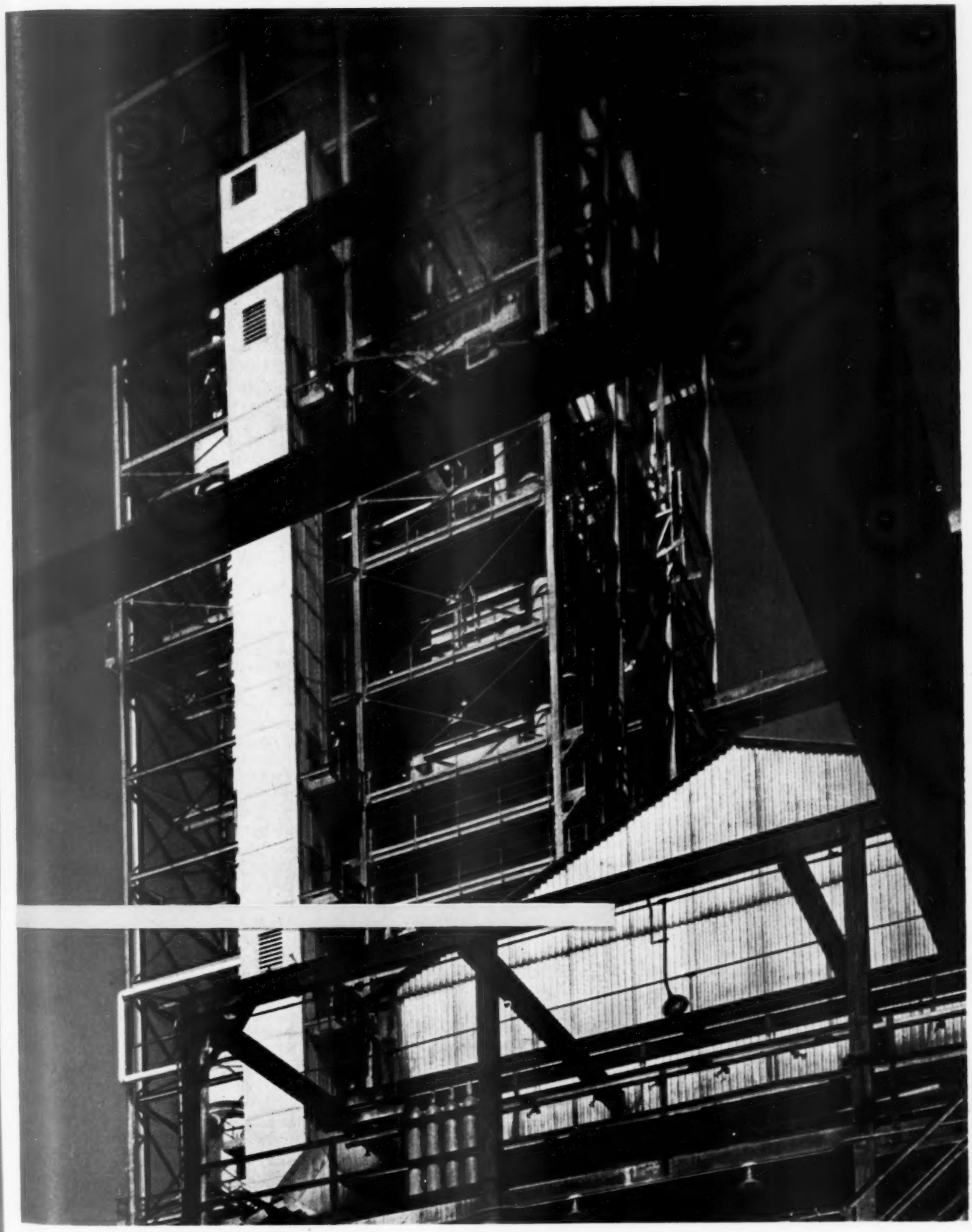

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Use of Cast Iron in Chemical And Process Industries

By F. L. LaQue

Extensive data are presented on the corrosion rates of cast iron exposed to the action of substances commonly handled in the petroleum refining and chemical processing industries. Factors dictating the choice of cast irons for corrosive service, the availability of the material, design for chemical industry equipment and specific applications are discussed. Results of laboratory and plant tests with many corrosive media are shown. Appended tables list many chemicals regularly handled by cast iron pumps and valves and those resisted satisfactorily by high silicon irons.

IN VIEW of the attention given the relatively new corrosion resisting alloys during the past few years, it may be surprising to many that cast iron has been referred to fairly recently as "the most important material of construction in chemical engineering"[1].

Cast iron has been able to maintain this position largely as a result of the great improvement in gray iron foundry practice and the utilization of alloying elements which have taken place within recent years. Moreover, it has been predicted[2] that the further application of cast iron in new processes "will depend only upon the recognition of properties it is possible to develop by the use of alloying elements".

The fact that cast iron has been used in large tonnages in chemical process equipment for a longer period than any other material of construction is traceable largely to the ready availability and low service cost of this engineering material.

With respect to the ready availability of cast iron, it will suffice to note that gray iron foundries are located in practically every community and that the remote chemical and process plants, such as pulp and paper mills, may have their own foundries for production of replacement parts. In the latter cases, the original design of processing equipment to make use of gray iron castings is especially important.

Supplementary advantages of gray cast iron that account for its choice in many instances include the facility with which it may be machined with ordinary tools in the field as well as in the shop, and its good anti-friction properties which enable it to run in rubbing contact with itself and other metals and alloys. Relative freedom from seizure and galling permits its use for bearings—lubricated or submerged—and the setting up of close clearances between moving parts, as in pumps and between agitator or scraper arms and kettle walls, with consequent improvements in operating efficiency. This freedom from galling is especially desirable in connection with the proper functioning of plug cocks.

Jacketted cast iron kettles have maintained their popularity for reasons such as these:

1. The many cast-in studs between the jacket and the kettle contribute to high heat transfer rates.

2. Scrapers can rub on gray cast iron kettle walls without galling. This is an especially important advantage in the processing of viscous materials.

3. Cast iron kettles are rigid and retain their shape on heating and cooling so that scraping devices maintain close and uniform contact with all areas to be scraped, thus avoiding excessive wear of high spots or failure to wipe low ones.

Factors Dictating Choice of Cast Iron

For the many purposes for which iron or steel offers adequate resistance to chemical attack, the choice of gray iron castings may be based on one or more of the following factors:

1. A casting most readily provides the shape required with appropriate distribution of mass where mass is needed for strength, rigidity and durability, and with none of the complications of distortion, special heat treatment and the opportunity for undesired electrolytic effects and occasional, difficult to locate and repair, leaks that may be associated with various types of joint.

2. Gray iron is the least expensive casting material.

3. Cast iron may demonstrate an advantage over other forms of iron or steel with respect to rates of corrosion, either as uniform attack or pitting.

4. Gray alloyed iron may be made strong enough; and it maintains its strength, and particularly its rigidity or stiffness, at moderately high temperatures, that is, up to about 1200° F.[3].

5. By suitable choice of composition and casting practice—as by the use of chills—cast iron may be provided with exceptional resistance to erosion or abrasion for use in sand and slurry pumps, grinding rolls, pug mills and the like. Chilled alloy iron, for example, showed outstanding performance in tests for die liners and muller tires in the ceramic industry[4].

The designer of chemical processing equipment to be made of cast iron should take the following points into consideration[5]:

1. Large flat surfaces should be avoided and the thickness of metal should be kept as uniform as possible.

2. Where inequalities in section thickness are unavoidable, the change in section should be gradual.

3. Sharp, square corners, whether internal or external, are a source of fracture and should always be avoided.

4. All large flanges should be webbed, and slots should be provided rather than bolt holes, particularly with high silicon irons.

5. Long projecting pipes in large vessels should be avoided, and the design generally should be kept as simple as possible.

6. The advice of the foundryman should be sought and followed in the early stages of design.

Corrosion Resistance Governing Factor

The nature of chemical processes is such that resistance to corrosion is always an important factor in the choice of a material of construction. Cast iron differs from other ferrous materials in the way it resists corrosion. This difference is related directly to the physical structure of cast iron and, particularly, to the presence of graphite flakes in a ferritic, pearlitic, or austenitic matrix. The corrosion resisting characteristics of gray iron may be altered by alloying and by foundry techniques since both affect the size, shape and distribution of the graphite particles and, in addition, influence the corrodibility of the matrix. Consequently, as compared with steel, there is a greater facility and more scope for improvement in the corrosion resistance of cast iron by use of small amounts of alloying elements.

The presence of graphite in gray iron frequently is a determining factor in the progress and distribution of corrosion. The graphite, itself, is insoluble in most corrosive media; and very often it is able to act as a binder, retaining other insoluble corrosion products in a coating which acts to provide an effective barrier against further penetration of the corrosive medium to the underlying iron. By breaking up the structure of the iron the graphite particles may also serve to interrupt the progress of small pits and thus to prevent highly localized corrosion,

Published by the Gray Iron Founder's Society, Inc., Washington.

F. L. LaQue is head of the Corrosion Engineering Section, Development and Research Division, International Nickel Co., Inc., New York City.

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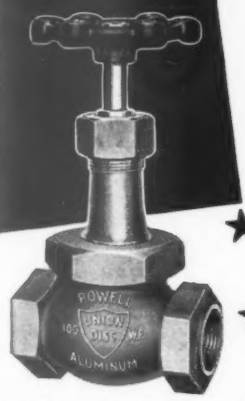

Fig. 1853 — Aluminum Globe Valve with screwed ends, union bonnet, and renewable vulcanized composition disc. Can be supplied with 18-8S stem.

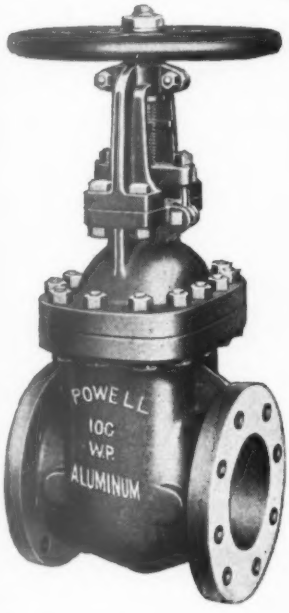

Fig. 2461—Large size Aluminum Gate Valve with flanged ends, bolted flanged bonnet, outside screw rising stem and taper wedge double disc. Can be supplied with 18-8S disc and stem.

Fig. 1859 — Aluminum Gate Valve. Screwed ends, screwed-in bonnet, inside screw rising stem and taper wedge double disc. For more severe service, we recommend 18-8S disc and stem.

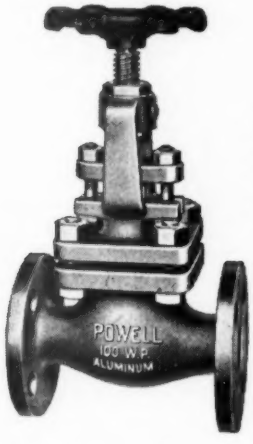

Fig. 1946 — Aluminum Gate Valve with flanged ends, bolted flanged bonnet, and outside screw rising stem. Taper wedge double disc in sizes 1" and larger. Also available with 18-8S disc and stem.

Fig. 2309A—Aluminum Flush Bottom Tank Valve for attaching to metal tanks and autoclaves. Also available with 18-8S disc, stem and seat plate. In this design the disc rises into the tank to open the valve.

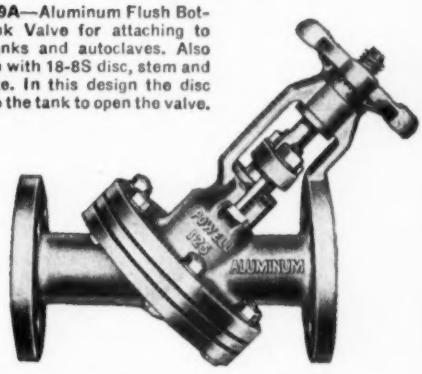

Fig. 1097A—Aluminum Separable Body Reversible Seat "Y" Valve. Also available with 18-8S disc, stem, lock nut, gland and seat plate. Lower half of the body can be unbolted and turned through an arc of 180 degrees to make a 90-degree angle valve, for special piping arrangement and to eliminate extra fittings.

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which is not frequently encountered in cast iron.

The effect of the graphite is not always beneficial, however. In some media, such as certain strong acids which form readily soluble iron corrosion products, the attack on the matrix actually may be accelerated by the galvanic cell set up between the graphite and the iron[6], if the structure of the cast iron and the distribution of the particles of graphite are such as to permit infiltration of the corrosive constituents into the body of the casting. While, under such circumstances, some improvement in performance can be achieved by alloying and foundry practice designed to secure a more favorable size, shape and distribution of the graphite particles and a "denser" iron, greater improvement may often be realized by the use of sufficient amounts of nickel, or nickel and copper, to develop an austenitic matrix more highly resistant to chemical attack and less active in its galvanic reaction with graphite[2], [6]. Another commonly used method of increasing the resistance of cast iron to active acids is by alloying with large amounts of silicon. This method will be discussed in greater detail later.

Even when conditions of exposure are such as to lead to considerable "graphitic" corrosion, however, gray iron may still be able to function satisfactorily as a container for liquids, provided the stresses to be withstood are not too high, as, for example, in pipes carrying water or other liquids under relatively low pressure. Under favorable circumstances, the nobility developed by the formation of an impervious coating high in graphite content reduces the galvanic effect between gray iron and non-ferrous alloys, such as bronzes.

It is impractical to attempt an exhaustive description of the behavior of cast iron in contact with the thousands of combinations of chemicals and conditions encountered in the chemical, process and allied industries. As a practical guide to the use of cast iron, however—and in addition to some general comments to follow—four tables have been appended.

Table 1 (*See p. R-812*) shows the results of a large number of corrosion tests in the chemical and process industries. Table 2 comprises a list of chemical plant services for which cast iron, austenitic cast iron and silicon iron pumps are considered suitable by the Hydraulic Institute. Table 3 represents the judgment and experience of the Crane Co. as to the suitability of cast iron and austenitic cast iron as materials for valve bodies employed in the handling of various corrosive solutions, and Table 4 provides a list of corrosive chemicals which are resisted satisfactorily by high silicon cast irons. (In this publication of this report, the above four tables have been limited to chemicals used in the petroleum industry—Editor)

Maximum Corrosive Service Per Dollar

In some cases, the nature of the chemical process or the corrosive media handled is such that, in spite of a fairly rapid rate of attack on cast iron, no other material can be expected to render long enough service to justify a higher initial cost. Or, again, the time required to show a profit on such investment would be so long as to introduce a serious danger of obsolescence before the required economical life would be reached. In such cases, either the thickness of the iron is increased to provide for the corrosion expected or the equipment is replaced as often as may be necessary. Such practice is confined, however, to processes where contamination of the product by iron compounds is not harmful or where any iron that may be dissolved may be removed by further processing.

The usefulness of gray iron may be extended considerably by the application of metallic and non-metallic protective coatings, as by electro-deposition, enamelling, spraying, and by lining with brick, graphite, and so forth.

Gray iron demonstrates good resistance to corrosion by alkaline solutions, by many organic compounds and by neutral and slightly acid solutions. In certain strong acids, such as sulfuric, nitric and crude phosphoric, iron acquires, as we have noted, protective corrosion products that permit its successful and economical use.

Gray iron resists sulfuric acid satisfactorily when the acid concentration exceeds about 70% by weight. Cast iron pots or pans have been used for decades for the concentration of sulfuric acid, as, for example, in the concentration of denitrated waste acids from 70 to 97%. Corrosion of such pots may be fairly rapid in initial stages, but as the pots are used a protective corrosion product coating is developed. The desirable[5].

In fuming sulfuric acid, cast iron may velopment of such coatings is favored by operations under uniform conditions, particularly as to temperature. Ageing, or normalizing, of pots prior to use is debe embrittled, especially if there should be segregation of graphite[7]. In plants in which sulfuric acid is made by the catalytic (contact) process, all cast iron pumps or pumps with cast iron casings and complex chromium nickel alloy impellors are in general use.

Cast iron vessels are employed in the manufacture of acetic, nitric and hydrochloric acids by action of concentrated sulfuric acid on appropriate salts of these other acids. The concentrated sulfuric acid, itself, is not too highly corrosive and, since the operating temperatures are above the boiling points of the other acids, there is no condensation to lead to corrosion by their vapor[3].

Sulfonators, nitrators and fatty acid stills are frequently constructed of cast iron, and this engineering material is also used successfully in the processing

TABLE 2—Chemical Liquids Used by Petroleum Refiners which are Regularly Handled by Cast Iron Pumps*

Chemical Liquid	All Cast Iron	Cast Iron Casing (Standard Fitted)	Austenitic Cast Iron	Silicon Iron
Acid, Sulfuric over 77%	x	...	...	x
Acid, Sulfuric (Boiling)	...	...	...	x
Acid, Sulfuric under 10%	...	...	...	x
Asphalt	x	...	...	...
Benzene, benzol	x	x	...	...
Benzine, petroleum ether	...	x	...	...
Brine				
Calcium chloride pH>8	x	...	...	...
Calcium and magnesium	...	...	x	...
Sea water	x	...	...	...
Carbon Tetrachloride	x	...	...	...
Ferric Sulfate	...	...	...	x
Ferrous Chloride	x	...	...	...
Ferrous Sulfate	x	...	...	...
Furfural	x	...	...	...
Gasoline	...	x	...	...
Heptane	...	x	...	...
Hydrogen Sulfide (in water)	...	...	x	...
Kerosine	x	x	...	...
Magnesium Chloride	...	...	...	x
Magnesium Sulfate	x	...	...	...
Naphtha	...	x	...	...
Oil				
Crude, asphalt base	...	x	...	...
Crude, paraffin base	...	x	...	...
Fuel, furnace	x	x	...	...
Kerosine	x	x	...	...
Lubricating	x	...	...	...
Mineral	x	...	...	...
Paraffin	x	x	...	...
Petroleum Ether	...	x	...	...
Potassium Chloride	x	...	...	...
Potassium Nitrate	x	...	...	...
Salt Water	x	...	x	...
Sea Water	x	...	...	...
Sodium Chloride	x	...	x	...
Tethraethyl Lead	x	x	...	...
Toluene	x	x	...	...
Water, distilled	...	x	...	...
Water, fresh	...	x	...	...
Water, Salt and Sea	x	...	x	...
Zinc Chloride	...	...	...	x

*Standards of Hydraulic Institute, Sect. G, 1941.

xIndicates materials used regularly. Failure to indicate use of austenitic cast iron or silicon iron does not mean that these are unsuitable but that other cast irons may be adequate.

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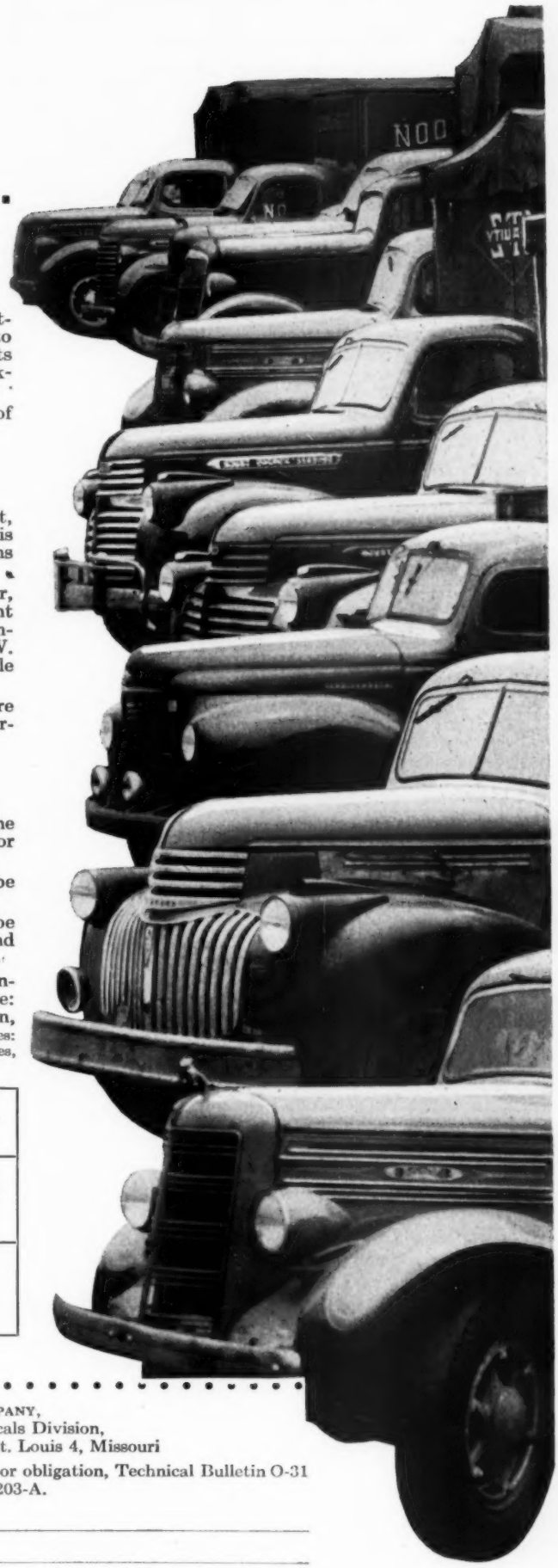

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of coal tar products, including crude tar acids and such refined products as phenols, benzene compounds and toluene.

Gray cast iron is highly resistant to alkaline solutions and finds many and important applications in equipment employed in the production of caustic soda by both the ammonia-soda and electrolytic processes. Improved life of equipment and reduced contamination of the caustic are achieved regularly by alloying the cast iron with nickel, and especially by the employment of regular and copper-free Ni-Resist. And gray cast iron has proved to be the most satisfactory material for fusion pots used in the production of anhydrous caustic soda.

Usable at Up to 1500° F. Temp.

Mention has been made of austenitic cast irons, the most common of which is Ni-Resist—gray cast iron containing about 20% of nickel, or nickel plus copper in the ratio of about 2.5 to 1. Another austenitic cast iron, developed in England particularly to resist scaling and growth at elevated temperatures, is called Nicrosilal. It contains approximately 18% nickel, 6% silicon and 2% chromium.

These austenitic cast irons demonstrate a very considerable improvement over an unalloyed iron or steel in resistance to corrosion by a variety of media, including mineral and organic acids, neutral and alkaline solutions, organic and inorganic sulfur compounds, petroleum products, and so forth. Quantitative data are provided in the appended Table 1.

Austenitic irons are considered to be superior to ordinary cast iron in resisting oxidation and growth at elevated temperatures and are suitable for use at temperatures up to about 1500° F., where small permanent dimensional changes may be tolerated. Advantage is taken of this property in many oil refinery applications[8] for such purposes as still tube supports, and in the gas industry[9] for such applications as gas producer shells and return bends, butterfly valves, and so forth, between coke ovens and gas collecting mains.

For services where the castings may be subjected to abrupt and considerable changes in temperature, so as to lead to high thermal stresses, it is desirable to employ a more highly alloyed composition which contains about 30% nickel and has a much lower coefficient of thermal expansion. Minimum thermal expansion may be provided by an iron which contains about 35% nickel.

For their resistance to liquid corrosion, the austenitic irons are employed in the petroleum industry[8] to handle crude oils, distillates, sulfuric acid and acid sludges, caustic solutions and refined products. Applications in this field include valves and fittings, pumps and pump liners, condenser sections, meters, and many others. In the soap industry, austenitic cast iron is used for fatty acid stills and for fatty acid and soap pickle filter press plates.

In the handling of caustic soda, austenitic irons are employed principally for pumps and pump parts and valves. Similarly, these alloys are found to be serviceable materials for the piping, valves and filters handling the alkaline solutions used in the manufacture of viscose rayon. The copper-free variety usually is preferred for these purposes.

Pumps, Pipes, Valves and Fittings

In the manufacture of paper pulp by the sulfite process an important application of austenitic iron is for blow pipes between digesters and blow pits. In the kraft, or sulfate process, considerable tonnages of cast iron are used for pumps, pipes, valves and fittings handling such alkaline sulfide solutions as black, green and white liquors[10]. Experience in this service has also shown a definite superiority of low nickel cast iron—up to 3% nickel—over alloy free cast iron for valve bodies and similar fittings.

In the salt industry, the austenitic irons have been found to be especially satisfactory materials for the bodies and grids of salt fillers and for the pumps and valves which handle both hot and cold brines.

By adding about 14.5% silicon to iron an alloy is produced which possesses remarkable resistance to a number of particularly troublesome corrosive media. These include both hot and cold sulfuric solutions with or without oxidizing compounds present, nitric acid, phosphoric acid, organic acids and acid salts. The ordinary silicon irons are not recommended[11] for use with bromine, fused alkalies, hydrofluoric acid, hydrofluosilicic acid when concentrated, and sulfurous acid. Strong, hot caustic solutions and some sulfites require special consideration. Resistance to hydrochloric acid, chlorine and acid chlorides is provided by the addition of about 3% molybdenum which functions by developing insoluble surface films in hydrochloric acid and in other acid chloride solutions.

TABLE 3—Chemicals Used by Petroleum Refiners Regularly Handled by Cast Iron Valves*

Chemical	Cast Iron	Austenitic Cast Iron (Ni-Resist)	Chemical	Cast Iron	Austenitic Cast Iron (Ni-Resist
Asphalt	x	x	Natural Gas	x	x
Benzene or benzol	x	x	Petroleum Oils, crude	x	x
Benzine	x	x	Potassium Chloride	x	x
Butane Gas	x	...	Producer Gas	x	...
Calcium Chloride	x	x	Propane Gas	x	...
Calcium Hydroxide	x	x	Sodium Chloride	x	...
Carbon Dioxide, dry	x	x	Sulfuric Acid (98% to fuming)	x	...
Carbon Dioxide, wet	x**	x**	Sulfuric Acid (7% to 9 %)	x	...
Carbon Tetrachloride	x**	x**	Sulfuric Acid (to 7 %	o	x**
Foamite Solutions (Alkaline)	x	x	Toluene	x	...
Furfural	x	...	Water, fresh	x	...
Gasoline, sour	x**	x**	Water, distilled	x	...
Gasoline, refined	x	x	Water Salt	x**	x
Hydrogen Gas	x	...			
Hydrogen Sulfide, dry	x	x			
Hydrogen Sulfide, wet	x**	x**			
Kerosine	x	...			
Lubricating Oils, sour	x**	x**			
Lubricating Oils, refined	x	...			
Magnesium Chloride	x**	...			
Magnesium Sulfate	x	...			

*Circular No. 312 (1939) Crane Co., Chicago.
**Use with caution.
x Indicates suitable. Failure to indicate use of austenitic cast iron by x does not mean it is unsuitable.
o Unsuitable.

TABLE 4—Corrosive Chemicals Resisted Satisfactorily by High Silicon Irons*

Chlorides of Zinc, Lead, Ammonium, Tin and Iron: a mixture
Ferric Nitrate
Ferric Sulfate
Ferrous Ammonium Sulfate
Ferrous Chloride
Ferrous Sulfate
Hydrogen Sulfide
Magnesium Chloride
Magnesium Sulfate
Phosphoric Acid
Potassium Chlorate and Hydrochloric Acid
Potassium Chloride
Potassium Nitrate
Sodium Chlorate
Sodium Chloride
Sulfuric Acid, all strengths

*Data courtesy of the Duriron Co., Inc., Dayton, O.

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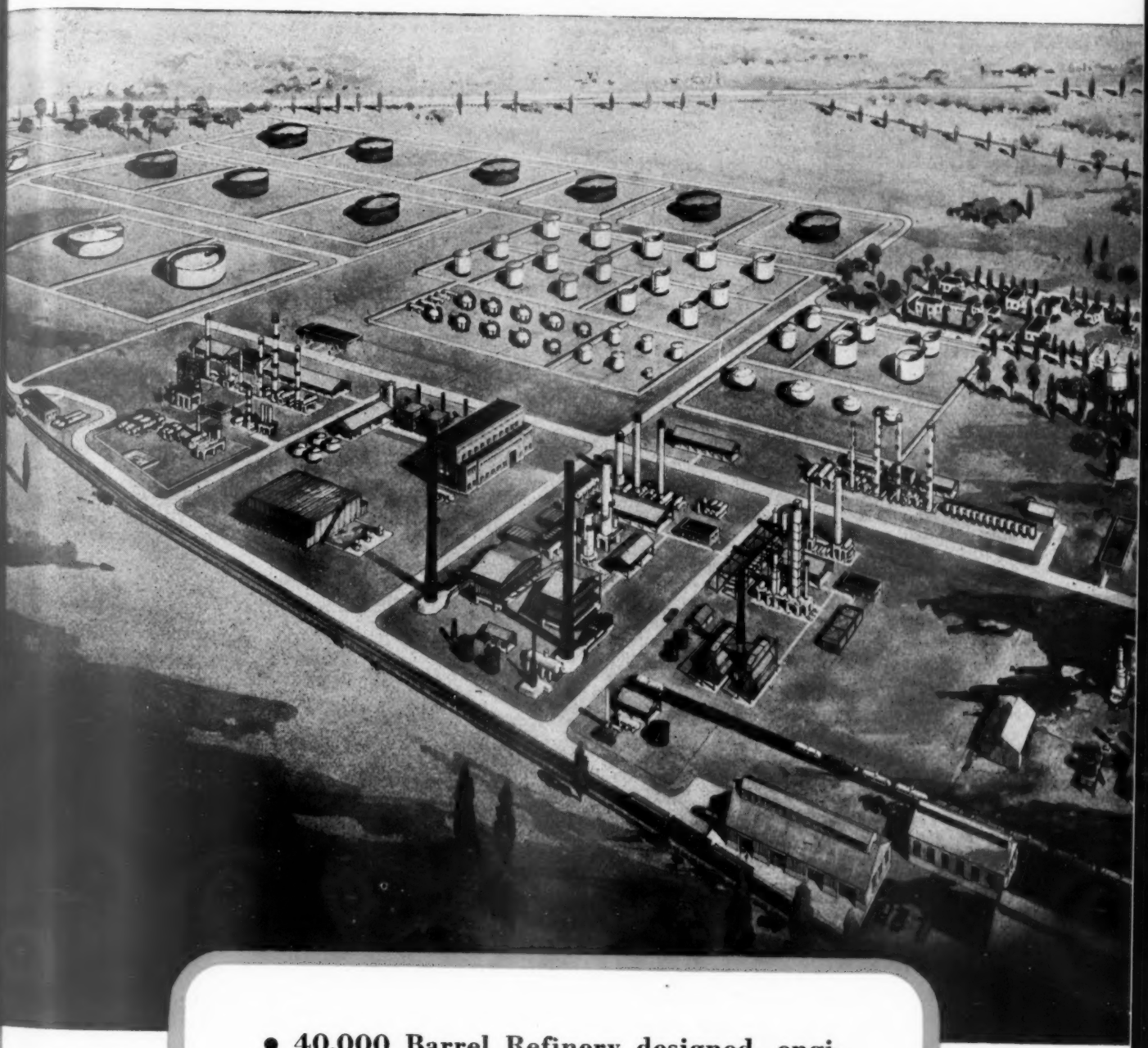

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TABLE 1—Selected Data from Laboratory and Plant Tests of Cast Iron and Austenitic Cast Iron in Chemical Solutions used by Petroleum Refiners

Corrosive Medium	Location of Test Specimens	Duration of Test	Temp. °F.	Aeration	Velocity	Average Corr. Rates in./yr. Cast Iron	Aust. C.I
Ammonium Hydroxide, 5%	Laboratory		60			No loss	0.00001
Ammonium Hydroxide, 10%	Laboratory		60			No loss	0.0002
Ammonium Hydroxide, 25%	Laboratory		60			No loss	0.00018
Ammonia solution, 50%	Laboratory		60			No loss	No loss
Ammonia solution, 75%	Laboratory		60			No loss	No loss
Ammonia solution, concentrated	Laboratory		60			0.002	No loss
Ammonia, 5-6% by vol.; 150 p.p.m.; Phenol carried by water vapor	Top of phenol tower	309 days	215.6	None	750,000 cu. ft./hr.	0.002	0.0009
Ammonia gas and liquor	Top of coke still	35 days				0.08	0.09
Ammonia liquors of 10 g/l Ammonia	Inside ammonia coils	318 days	77		By flow		0.0002
Ammonia liquors of 10 g/l Ammonia	Inside ammonia coils	318 days	158		By flow		0.006
Ammonia liquor	Ammonia liquor separator tank	225 days				0.00009	0.00005
Ammonia liquors of 6.5 g/l Ammonia	Liquor balance tank	307 days	215.6	None	1500 gal./hr.	0.003	0.0006
Ammonia liquors carrying Sulfates, Sulfides, etc.	Feed tank	449 days	100	Slight	By flow	0.0001	0.00001
Benzol liquid	Still body	146 days				0.004	0.001
Benzol condensate	In divided flow box	146 days				0.07	0.06
Benzol liquid, plus Sulfuric Acid	In benzol agitator	145 days		None	Some	0.05	0.03
Calcium Chloride, 5%	Laboratory		60	Some	None	0.009	0.005
Calcium Chloride, 5%, plus Magnesium Chloride, 5%	Laboratory		60	Some	None	0.005	0.004
Calcium Chloride cooling brine with Potassium Dichromate inhibitor	Brine tank	372 days		None	Slow circulation	0.0004	0.00009
Calcium Chloride cooling brine	Brine tank	355 days		None	Slow circulation	0.007	0.001
Calcium-Sodium-Magnesium Chloride brines in 28% concentration	Evaporator at liquid level	752.5 hours	160	Good	By boiling	0.02	0.003
Calcium-Magnesium Chloride brine; 50% total chlorides	Evaporator at liquid level	26 days	Boiling	Good	By boiling	0.03	0.004
Calcium Hydroxide, saturated solution	Laboratory	20 hours	86	With CO_2 free air	15.3'/sec.		Slight gain in weight
Calcium Hydroxide (Lime water)	Laboratory		60	Some	None	0.003	0.0002
Carbon Dioxide gas from boiler, with traces of H_2S	Gas scrubber	140 days	Unreported; hot gas enters at high temperature			0.06	0.045
Carbon Dioxide, saturated aqueous solution	Laboratory		60	Some		0.03	0.001
Carbon Tetrachloride	Sump tank, dry cleaning machine	66 days	70-90				0.001
Carbon Tetrachloride	Main still-vapor, dry cleaning machine	66 days	160-170				0.0003
Carbon Tetrachloride	Main still-liquid, dry cleaning machine	66 days	160-170				0.001
Carbon Tetrachloride	Main storage tank, dry cleaning machine	98 days	Room				0.002
Carbon Tetrachloride vapor containing S_2Cl_2 and CS_2	Vapor stream above top plate of bubble cap rectification column	133 days	171	None	Considerable flow	0.007	0.0005
Carbon Tetrachloride, crude	Plate 19 of bubble cap rectification column, 3 plates above feed plate	133 days	176	None	Violent	0.005	0.0004
Carbon Tetrachloride, 90%; Benzol 10%-Kolene Solvent	Storage tank	40 days	Room	None	None	0.02	0.0006
Carbon Tetrachloride, 90%; Benzol 10%-Kolene Solvent	Bottom of still	38 days	287	None	By boiling	0.004	0.002
Gasoline vapor of straight run (63° A. P. I.)	Lower section above No. 16 tray of stabilizer	6252 hours	375		95 p.s.i press.	0.006	0.002
Gasoline, straight run (63° A. P. I.)	5' above bottom of reflux accumulator	6252 hours	110		60 p.s.i. press.	0.003	0.002
Gasoline, straight run, with some HCl and H_2S	Top tray of bubble tower in topping unit	116 days	250-260	None	Rapid due to bubbling	0.05	0.01
Gasoline, cracked, with some HCl and H_2S	Top tray of bubble tower in Donnelly cracking unit	116 days	400-415	None	Rapid due to bubbling	0.002	0.001
Gasoline, aviation	Base of column below packing in Stedman fractionating column	13 days	225	Slight	Vaporstream 25'/sec.	0.002	0.0006
Gasoline: distilled tops from straight run with 0.025-0.05 g/l H_2S	Separator tank of reflux pump	23 days	95; endpoint 240-260	None	By liquid flow	0.23	0.024
Hydrochloric Acid, normal, 3.6%	Laboratory	24 hrs.	59	None	None	2.7	
Hydrochloric Acid, 36%	Laboratory	24 hrs.	59	None	None	6.6	
Hydrochloric Acid, 20% by vol.; concentrated acid	Laboratory	24 hrs.	134	Some	Some	17.1	

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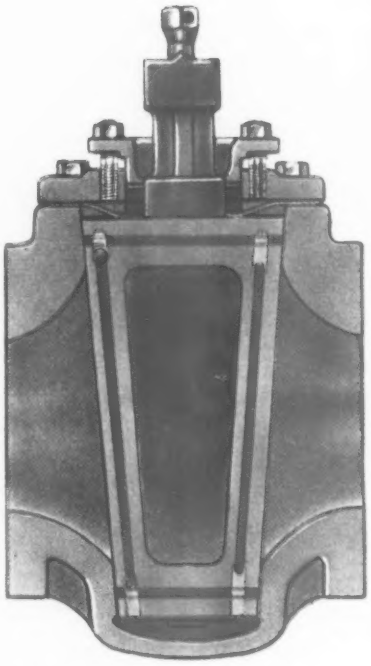

"Sealdport" grooves completely surround closed ports. In the above illustration the yellow areas indicate "tail" grooves in the body which connect with the vertical lubricant grooves in the plug, to form an unbroken circuit of pressure, regardless of position of the plug.

Full circumferential grooves are provided above and below ports. Lubricant enters unexposed long grooves in plug which lead directly to jacking chamber under plug. A few turns of the lubricant screw at top of plug forces lubricant through the grooves and lifts plug, if overly tight.

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The details of groove arrangements vary somewhat in different styles of Nordstrom Valves. However, all of the systems have two things in common—supply of a complete film around closed ports and cut-offs of any exposed portions of the grooves. The vital need for lubricant is evident. No *un*lubricated valve can offer such a positive seal against leakage or equal certainty of easy turning. Nordstrom engineering principles insure most efficient operation regardless of conditions.

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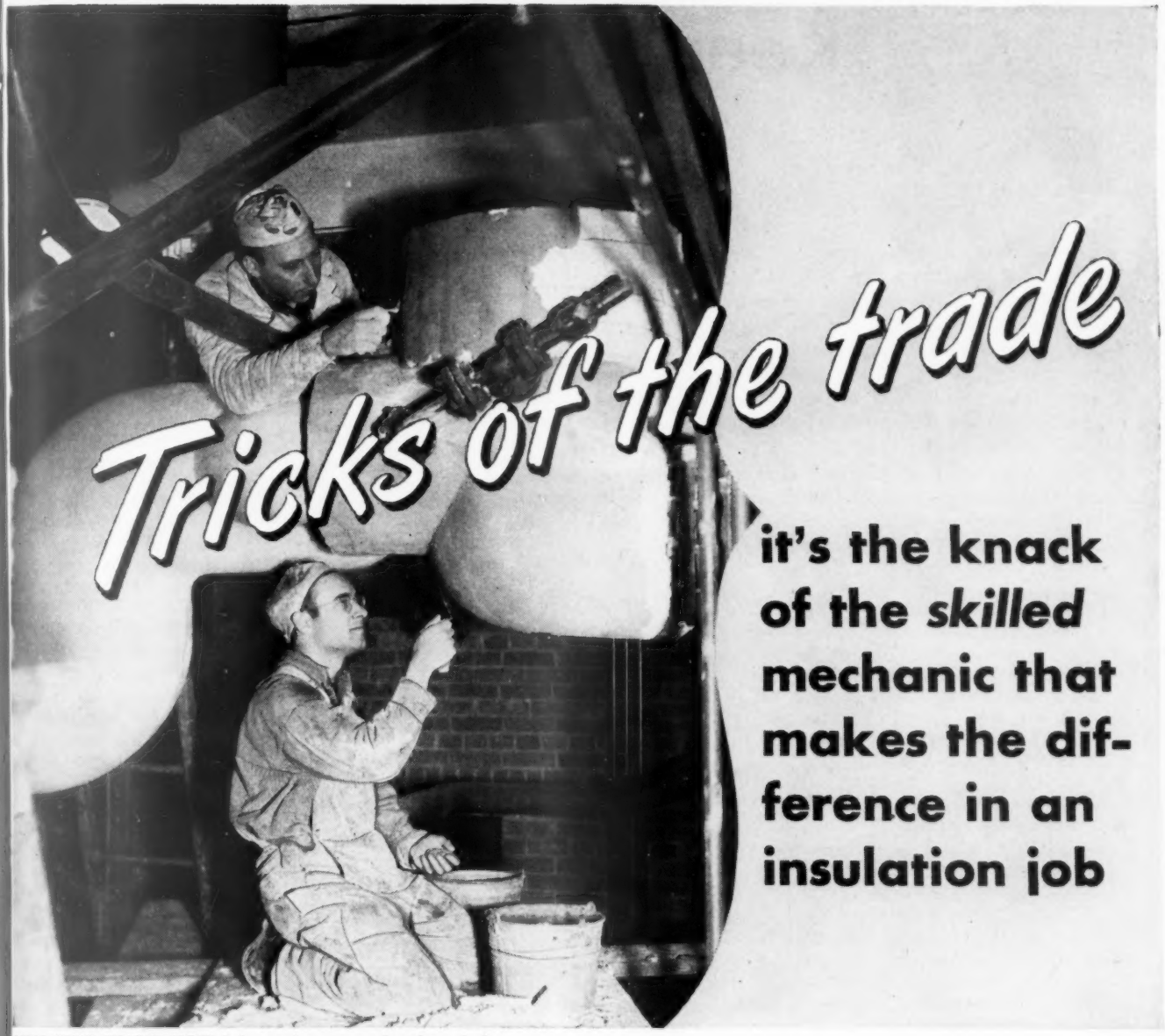
TABLE 1—Continued

Corrosive Medium	Location of Test Specimens	Duration of Test	Temp. °F.	Aeration	Velocity	Average Corr. Rates in./yr. Cast Iron	Aust. C.I.
Hydrochloric Acid, 2.8%; later wet Hydrochloric Acid fumes	Laboratory	340 hrs.	75	.....	None reported	2.23	0.11
Hydrochloric Acid 128 lbs. and 800 gals. Aniline for 104 hours and Hydrochloric Acid 2000 lbs. and Aniline 1200 gals. for 100 hours	Laboratory	204 hrs.	392	None	Mechanically stirred	1.23	0.54
Hydrochloric Acid, 5% by vol.	Laboratory	.....	60	Some	None	1.07	0.01
Hydrochloric Acid, 10% by vol.	Laboratory	.....	60	Some	None	1.22	0.009
Hydrochloric Acid, 25% by vol.	Laboratory	.....	60	Some	None	1.22	0.02
Hydrochloric Acid, 50% by vol.	Laboratory	.....	60	Some	None	1.24	0.04
Hydrochloric Acid, 75% by vol.	Laboratory	.....	60	Some	None	1.22	0.12
Hydrochloric Acid, concentrated	Laboratory	.....	60	Some	None	1.11	0.37
Hydrochloric Acid, 1%	Laboratory	.....	Room	.....	.....	0.20	0.006
Hydrochloric Acid, 2%	Laboratory	.....	68	.....	.....	0.88	0.005
Hydrochloric Acid, 3.7%	Laboratory	.....	68	.....	.....	5.18	0.015
Hydrochloric Acid, 5%	Laboratory	.....	Room	.....	.....	0.672	0.01
Hydrochloric Acid, 20%	Laboratory	.....	Room	.....	.....	2.24	0.012
Hydrochloric Acid, 5%	Laboratory	.....	130	Complete	.....	5.33	0.099
Hydrochloric Acid, 10%	Laboratory	.....	130	Complete	.....	5.90	0.12
Hydrochloric Acid, 20%	Laboratory	.....	130	Complete	.....	6.65	0.22
Hydrochloric Acid gas made by volatilizing 31.5% Hydrochloric Acid	Hollow shaft leading to carbonizer	37 days	220	Some air enters with HCl	.....	0.02	0.01
Hydrochloric Acid, 2%	Apple washer	192 hrs.	80-120	Complete	Slight	2.9	0.11
Hydrofluoric Acid, 10%	Laboratory	30 days	50-70	.....	.....	0.22	0.001
Hydrogen Chloride	Laboratory	15 hrs.	212	.....	.....	0.04	.....
	Laboratory	15 hrs.	572	.....	.....	0.05	.....
	Laboratory	15 hrs.	932	.....	.....	0.40	.....
	Laboratory	15 hrs.	1292	.....	.....	3.03	.....
Hydrogen Sulfide, moist	Laboratory	7 days	200	.....	.....	0.07	0.01
Hydrogen Sulfide, 98%; balance air and N_2	Gas path of extraction unit	188 days	90	Good	By gas flow	0.003	0.002
Naphtha, plus 15-30% of a mixture of Oleic, Linoleic and Abietic acids	At bottom of scrubber	196 days	Room to 570	None	None	0.002	0.0002
Naphtha; rerun acid treated with mercaptans	Look box	33 days	Room	None	By flow	0.18	0.03
Naphtha; rerun acid treated with mercaptans	The still	11 days	400	None	By flow	0.74	0.19
Naphtha; rerun acid treated	Naphtha stream from battery	78 days	100-110	.....	.....	0.40	0.03
Naphthalene washing with 1.1-1.3% by vol. 66° Be H_2SO_4 washing and neutralizing with 8-16% by vol. 10% Caustic Soda	Inlet pipe at bottom of treating tank	20 days	200-210	Air sat'd by blowing air through	Agitated by air	0.13	0.04
Naphthalene, crude, plus Sulphuric Acid	Bottom of washer	10 days	185-203	Negligible	Mechanical agitation	2.14	0.45
Naphthenic acids in distillate from South American petroleum (low velocity liquid phase)	Bottom primary fractionating column	174 days	500	None	Low liquid velocity	0.008	0.003
Naphthenic acids in heavy distillate from South American petroleum	Between trays 6 and 7 of second fractionating column	59 days	554	None	By flow	0.008	0.01
Oil, sour lube (2% Sulfuric Acid, 58% Hydrocarbons, 40% water)	Agitator	365 hrs.	100	None	None	0.16	0.02
Oil, condensate of light gas, non-condensible gases and steam	Condensate line	1176 hrs.	90-120	.....	.....	0.03	0.007
Petroleum: crude oil and H_2SO_4	Crude oil agitator	92 mo.	Atmospheric	.....	Some	0.04	0.003
Petroleum: crude oil vapors	Vapor section of bubble tower	2 mo.	250	.....	.....	0.18	0.05
Petroleum: Ranger low S crude	Above highest baffle below lowest of 10 bubble trays	1701 hrs.	640	.....	170 p.s.i. pressure	0.02	0.01
Petroleum: oil with Hydrochloric Acid and Hydrogen Sulfide vapors	In vapors at top of crude oil bubble tower	7 days	235	None	Some	1.15	0.4
Petroleum: lubricating oil vapor with Hydrochloric and organic acids	In vapor line of still	10 days	700	.....	.....	0.51	0.13
Petroleum: lubricating oil with Hydrochloric and organic acids	In still	10 days	700	.....	.....	0.67	0.13
Petroleum: vapors from fractionation of Illinois crude	In vapor section of fractionating tower	564 hrs.	745	None	Slight	0.05	0.04
Phenol, 5%	Laboratory	.....	60	Some	None	0.008	0.009
Phosphoric Acid, 5%	Laboratory	24 hrs.	86	None	15.7'/min.	4.85	0.08
Phosphoric Acid, 5%	Laboratory	24 hrs.	86	Some	15.7'/min.	.....	0.12
Phosphoric Acid, 15%	Laboratory	20 hrs.	86	Some	15.7'/min.	.....	0.08
Phosphoric Acid, 15%	Laboratory	24 hrs.	86	None	15.7'/min.	5.05	0.05
Phosphoric Acid, 25%	Laboratory	24 hrs.	86	None	15.7'/min.	3.79	0.04

(*Continued on page R-814*)

TABLE 1—Continued

Corrosive Medium	Location of Test Specimens	Duration of Test	Temp. °F.	Aeration	Velocity	Average Corr. Rates in./yr. Cast Iron	Aust. C.I.
Phosphoric Acid, 25%	Laboratory	24 hrs.	86	Some	15.7'/min.	.....	0.07
Phosphoric Acid, 5%	Laboratory	21 hrs.	190	None	15.5'/min.	34.73	0.28
Phosphoric Acid, 5%	Laboratory	21 hrs.	190	Some	15.5'/min.	.....	0.37
Phosphoric Acid, 15%	Laboratory	20 hrs.	190	Some	15.5'/min.	.....	0.49
Phosphoric Acid, 15%	Laboratory	20 hrs.	190	None	15.5'/min.	58.42	0.32
Phosphoric Acid, 25%	Laboratory	20 hrs.	190	None	15.5'/min.	65.64	0.03
Phosphoric Acid, 25%	Laboratory	20 hrs.	190	Some	15.5'/min.	.....	0.76
Phosphoric Acid, 25%	Laboratory	24 hrs.	190	Some	15.5'/min.	.....	0.39
Phosphoric Acid (tetra), concentrated	Laboratory	.....	Varying	None	.....	.....	0.02
Phosphoric Acid, 80-90%, and oxidizing substance	In launder acid from precipitator	7-80 days	200	.....	.....	1.69	0.02
Phosphoric Acid, 78% crude	Storage tank	.....	125-150	Tank open	Some	0.42	0.25
Phosphoric Acid (tetra), concentrated, 83.5-84.5% P_2O_5	Laboratory	48 hrs.	140	None	None	.....	0.0019
	Laboratory	48 hrs.	248	None	None	.....	0.03
	Laboratory	48 hrs.	356	None	None	.....	0.02
Phosphoric Acid, 1%	Pickling tank	51 days	190	Some	Slight, provided from open jet heating	.....	0.05
Phosphoric Acid, 12%	Pickling tank	5524 hrs.	70-212	.....	Each day by steam	0.13	0.06
Steam	In a nipple expanded from high pressure steam line	31 days	350	Good	120 lb. pressure	0.002	0.0007
Steam condensate with dissolved O and CO_2	In condensate return line	30 days	180	Good	By flow	0.002	0.00004
Steam condensate and cooling water	In nipples expanded from steam lines	30 days	60-200	Good	By flow	0.04	0.02
Steam condensate from drying process for artificial leather	In condensate receiver	1848 hrs.	220	Air removed in part thru air vent	By flow	0.05	0.04
Sulfuric Acid, 5%	Laboratory	24 hrs.	Room	None	None	4.42	.....
	Laboratory	24 hrs.	Room	Some	None	4.98	.....
Sulfuric Acid, 60° Be	Laboratory	4 hrs.	203-212	.....	None	.....	0.62
	Laboratory	10 hrs.	203-212	.....	None	.....	0.56
Sulfuric Acid, 7.8%	Laboratory	4 hrs.	203-212	.....	None	.....	0.4
Sulfuric Acid, 5%	Laboratory	20 hrs.	86	None	None	.....	0.02
	Laboratory	20 hrs.	194	None	None	.....	0.38
	Laboratory	20 hrs.	86	None	15.5'/min.	.....	0.09
	Laboratory	20 hrs.	194	None	15.5'/min.	.....	0.81
Sulfuric Acid, 10%	Laboratory	20 hrs.	86	None	None	.....	0.02
	Laboratory	20 hrs.	194	None	None	.....	0.53
	Laboratory	20 hrs.	86	None	15.5'/min.	.....	0.08
	Laboratory	20 hrs.	194	None	15.5'/min.	.....	1.21
Sulfuric Acid, 30%	Laboratory	20 hrs.	80	None	None	.....	0.05
	Laboratory	20 hrs.	194	None	None	.....	1.29
	Laboratory	20 hrs.	86	None	15.5'/min.	.....	0.06
	Laboratory	20 hrs.	194	None	15.5'/min.	.....	2.52
Sulfuric Acid, 80%	Laboratory	20 hrs.	86	None	None	.....	0.02
	Laboratory	20 hrs.	194	None	None	.....	0.25
	Laboratory	20 hrs.	86	None	15.5'/min.	.....	0.02
	Laboratory	20 hrs.	194	None	15.5'/min.	.....	0.50
Sulfuric Acid, 85%	Laboratory	90 days	120-140	.....	.....	.....	0.09
Sulfuric Acid, 86%	Laboratory	30 days	120-140	.....	.....	.....	0.03
Sulfuric Acid, dilute, and Sulfurous Acid in water	In effluent water from smoke scrubber	11 days	.....	.....	.....	0.78	0.15
Sulfuric Acid, dilute, and Sulfurous Acid, dilute, in water	In effluent water from smoke scrubber	11 days	130	Some	.....	0.78	0.14
Sulfuric Acid, very dilute, and traces of H_2S	In processing tank	3 weeks	150	None	Slight ebullition	0.13	0.03
Sulfuric Acid made from Benzol Agitator (40% by vol. H_2SO_4), containing some sludge	In acid regenerator	30 days	260	None	Some	Completely destroyed	0.04
Sulfuric Acid and oils	In oil sulfonator	8 batches	.....	.....	Stirred	0.23	0.003
Sulfuric Acid, 25%, and acid sludge	In discharge line	1326 hrs.	140	.....	Forced flow	Completely destroyed	0.008
Sulfuric Acid 66° Be, plus various amounts of Nitrous Acid generated by continuous addition of Sodium Nitrite	In dye developing tank	9 days	175	Slight	Slight	1.72	.....
	In dye developing tank	36 days	175	Slight	Slight	.....	0.22
Sulfuric Acid, 72%, Polymer Gasoline, Butane and Butylenes	In gasoline tower	237 days	175	.....	Due to bubble caps	0.07	0.02
Sulfuric Acid, 10%, and 2% Copper Sulfate	In spray pickling machine	176 hrs.	90	Good	Spray at 40 p.s.i.	1.54	0.62



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Keeping Up With the News

By N.P.N. Special Writer

This series is an attempt to correlate, in a technical-economic manner, important current happenings in scientific and industrial circles which may bear some relation to the future of the petroleum industry.

The industry, as a whole, is now much interested in problems of future supply, possible substitutes, and the relationship of all of these to such competing fuels as coal and gas. For this reason, this month's discussion of tar sands is of particular significance, as is an analysis of information on atomic energy and the atomic bomb. Other topics covered include Diesel oils and carbon black.

The author of this series is a chemical engineer in the employ of the research subsidiary of one of the larger oil companies. His duties include a continuous survey of the current technical and economic journals in the many fields now related to petroleum operations.

Tar Sands

Mention was made last month(1) of the prospective return to private ownership of the Canadian government's tar sands project at McMurray in Northern Alberta. Potential use of tar sands continues to intrigue petroleum interests in both Canada and the U. S., especially since the latter is not completely devoid of such materials.(2)

Abasand Oils, Ltd., is not the only Canadian concern which is engaging in semi-commercial operations. Oil Sands, Ltd., organized in 1943, has an experimental plant about 50 miles north of McMurray on the Athabaska River and is planning to complete a 350 b/d separation plant and refinery by next summer.

Figures released by executives of both companies(3) are of interest in that they provide one of the few means of evaluating the near-future economics of tar-sand developments. Harold C. Spaetgens, superintendent of Abasand's 600 b/d refinery (designed by Universal Oil Products Co.) states that his company hopes to produce the "crude oil" for $1.00-$1.25 per barrel, a cost "which would make its products competitive on a price basis." Refining costs, expected to average 50-60 cents per barrel, "will be competitive. The whole future depends on how cheaply we can mine the sand and separate out the oil."

Martin Nielsen, technical engineer of Oil Sands, Ltd., "figures it will cost 36 cents a ton to mine and transport oil sand to the plant. A ton of sand contains about a barrel of oil. L. R. Champion, president of Oil Sands, estimates that separation will bring the cost of the crude oil to about $1 a barrel. Refining cost will amount to between 50 and 75 cents per barrel, depending on what products are made, according to Mr. Nielsen."

The Abasand refinery, at present, produces 56% asphalt, 19% fuel oil, 10% Diesel oil, 7% gasoline (68-70 octane), and 6% diluent (reused in the separation of the oil from the sands). "Both companies at the outset will concentrate on the production of asphalt," since the latter is easier and cheaper to produce than gasoline, is said to be of excellent quality, and commands a good price ($32 per ton at Edmonton). The other products are used as fuel for the plants and for the companies' vehicles.

If the planned units prove profitable, larger-scale production of gasoline may then be attempted. The Dominion's Department of Mines and Resources has been engaged in hydrogenation experiments, since this process gives higher yields than cracking, but initial plant costs would be considerably higher, "and it is believed that hydrogenation wouldn't pay in a plant treating less than 10,000 barrels a day."

The remoteness of the deposits is a handicap to their development. Only a single-track railroad links Fort McMurray with Edmonton, 250 miles to the south; Seattle is 770 miles away. "There is no automobile road to the outside world. Volume marketing of light oil products or gasoline would require a pipeline to Edmonton; Mr. Champion believes a pipeline could lay oil in Edmonton at $1.20 a barrel."

The extent of the Alberta tar sand deposits has never been accurately determined; "oil" content may lie between 100-250 billion barrels, a fabulous figure. Unfortunately, however, only a few billion barrels lie close enough to the surface to be susceptible to "strip mining," and no commercial in situ separation process has yet appeared.

In addition, "the tar sands themselves are not uniform, either in thickness, oil content, or amount of clay and other foreign matter mixed with them. This runs up the cost of separation. Another objection is the oil's high sulfur content. This is about 5% at Abasand. Mr. Spaetgens says that most of this is retained in the asphalt." High sulfur content would be another good reason for refining by hydrogenation.

The separation process to be used at Abasand's plant, when reconstruction is completed, seems similar to that used experimentally by the Bureau of Mines on California tar sands.(1) The tar sand is mixed with water which has been heated to 180°F., and a "thin oil about the consistency of kerosine" is added "to cut the heavy oil as it comes off the sand," which latter is then separated by a flotation process.

Atomic Energy

Not quite two months have passed since the world was awakened to the news that man had conquered the atom, that a "new" source of energy was available as a potential competitor to coal, petroleum, fuel gases, and hydroelectric plants.

The announcement was explosive in more ways than one. The purely military aspects of the discovery, however, overwhelming as they are, will fade into the background if peace can be maintained, while the economic significance will come more and more to the fore—if Governmental restrictions do not, through undue precautionary measures, stifle or delay developments.

Almost every scientist in the country, by this time, will have reviewed all that he ever knew of atomic physics in an effort to understand the startling new developments. The layman, similarly, has been deluged with "physics made easy" accounts of atomic theory and can talk glibly of atomic nuclei, electrons, protons, neutrons, beta rays, U-235, U-238, plutonium, and other topics about which nothing had even been written for

(1) Anon., *NATIONAL PETROLEUM NEWS, Technical Section*, 37, No. 36, R-744 (1945), "Keeping Up With the News—Petroleum Substitutes."

(2) *Ibid.* 36, No. 40, R-725 (1944), "Keeping Up With the News—Gasolines from Tar Sands; Domestic Tar Sands."

(3) McWethy, J. A., *Wall Street Journal CXXVI*, No. 29, 1 (1945), "Strip Mining Oil."

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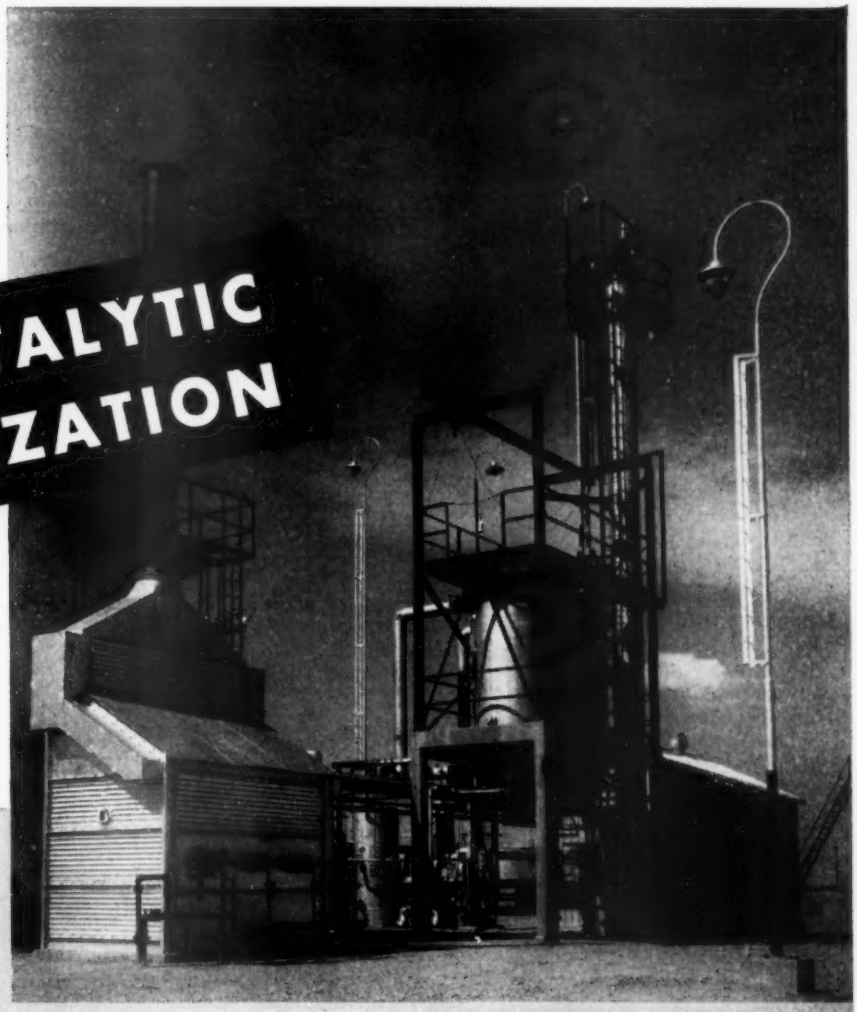

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several years, because of censorship.

Some of these simplified accounts have really done credit to the popular scientific press.[4], [5] This has been a real achievement in view of the secrecy which still surrounds the facts of the matter, and a perusal of several articles provides a degree of understanding which makes part of the remaining censorship seem futile.

Space does not permit more than a skeleton summarization of what seem to be basic facts. In essence, they are:

(1) Atomic physicists have found that the neutron bombardment of the nucleus of uranium-235 (U-235) causes that nucleus to disintegrate, with violent release of energy, into such lighter elements as krypton and barium, with concurrent release of one to three neutrons (and dangerous radioactive rays):

(2) Depending upon whether an explosion is desired or just the release of energy (through transmutation of mass), the above reaction can be permitted to run unchecked (for the first effect) or controlled (by use of barriers, etc.) to the extent that the chain reaction is simply maintained, not accelerated or allowed to die prematurely. Both require the presence of the "critical mass" needed to keep the reaction going once it starts; i.e., to provide sufficient neutrons for the chain, since many are "wasted." Also needed (except in the bomb) is a "moderator", such as graphite, paraffin, heavy water, or regular water; this serves to slow down the neutrons, minimizing "misses";

(3) When controlled disintegration is in progress, one of the extra protons from the active U-235 may enter the nucleus of "inactive" U-238, which is present in natural uranium in a ratio of 139 to 1 to U-235. A new uranium isotope, U-239, is created, but this is highly unstable, breaking down quickly into a new element, neptunium, which, while more stable, also spontaneously decomposes into a second new element, plutonium. Plutonium is much more stable, and, since it can be "exploded" in a manner similar to U-235, much attention has been given to this synthesis.

This is particularly true since plutonium is chemically separable (albeit under difficult and dangerous conditions, requiring elaborate automatic equipment) from the uranium left over in its synthesis, being a different element, while U-235 can be separated from U-238 or concentrated in admixture with it only at tremendous expense. Nevertheless, three large-scale processes are said to have been developed, since concentrated U-235 must be used in the bomb (if plutonium is not used) or, perhaps, in the plutonium-synthesis "pile," in order to reduce the necessary "critical mass."

No purpose would be served here by a further account of basic theory; this is admirably presented in references (4) and (5). What is of particular significance to the petroleum industry, however, is the vast release of energy per pound of matter destroyed: 11,400,000,000 kilowatt hours, the equivalent (energy-wise) of about 1,500,000 tons of coal or more than 200,000,000 gallons of gasoline.

A note of caution is necessary in such calculations, however; the "conversion" of a pound of U-235 yields products (krypton, barium, etc.) which weigh about 0.9990 lb., hence only .001 lb. of the mass is converted into energy, or 11,400,000 kilowatt-hours per pound of U-235 charged. The coal and gasoline equivalents, therefore, are actually 1,500 tons and 200,000 gallons, respectively.

It has been pointed out[4] that at least seven factors may restrict the use of atomic energy:

"(1) the ineffectiveness of large piles using the normal U-235 concentration (i.e., natural uranium isotope mixtures),

(2) the high cost of concentrated U-235 for smaller, more effective piles,

(3) the danger from radioactivity;

(4) the weight and cost of shielding against radiation,

(5) the explosion hazard, (6) a possible short supply of uranium, and

(7) Governmental restrictions on atomic-energy materials."

If atomic energy is actually used industrially, it may very well be used in connection with present mechanisms, since, from controlled U-235 "piles," it is available in the form of heat. This, with suitable safeguards, could be used:

(1) to heat water for processes or space heating;

(2) to make steam for processes, space heating, or the generation of electrical and mechanical power (such as through the steam turbine);

(3) to heat air for processes (drying, etc.) or space heating;

(4) to operate a gas turbine through the use of a circulating heat-transfer fluid.

New prime movers, of course, may be developed.

According to reference (4), "it seems fairly safe to predict that atomic energy will find some commercial applications within the next five or ten years, first, probably, as a premium fuel, worth a fancy price for specialized applications where low weight or some other characteristic is important.

"As the cost of concentrating U-235 is reduced and application efficiencies improved, atomic energy may compete with cheaper fuels, ultimately with coal."

Other possible applications include high-temperature processing, medical use of the radioactivity produced, and even "modern alchemy," the production of one element from another. Knowledge gained from further research may eventually lead to methods of tapping the energy of nonradioactive elements, a prospect which would negate an eventual shortage of uranium.

Diesel Oils

The recent war was witness to an astonishing growth in the production of many materials. It saw domestic 100-octane gasoline production increase from 58,000 b/d, in late 1941, to 530,000 b/d by the end of hostilities. Butadiene production from petroleum, similarly, leaped from a few thousand tons per year to several hundred thousand tons.

One of the most significant developments, however, and one which bids fair to carry over into peacetime, has been a phenomenal increase in the consumption of Diesel oil. "Its use today (July) is more than treble the rate in 1941 when the 27,351,000 barrels consumed represented only 16% of all fuel oil sold."[6]

The chief factor in this wartime increase has been naval demand, for Navy Diesel power has grown from 150,000 h.p. at the end of World War I to more than 34,000,000 h.p. at the present time, the latter being the latest aggregate of installations in naval vessels and stations. Naturally, the use of this capacity—which greatly exceeds the cumulative horsepower of all the Diesels ever manufactured in this country prior to 1942 (some 19,930,000 h.p.)—will continue to diminish, as naval operations are concluded and excess ships are put in drydock, but other uses are expected "to take up the slack."

If Diesel oil consumption continues to increase, as predicted, higher prices seem inevitable. "Until its use began to skyrocket, Diesel oil was the 'little brother' of heating oil. Dealers handled it as a sideline to their regular business at an extremely small margin of profit. The small handling cost was absorbed by the costs for heating oil.

"This 'free riding' ended, however, as its expanded use increased transportation and handling costs, and it,

(4) Anon., *Business Week*, No. 832, 15; No. 833, 21; No. 835, 57 (1945).

(5) Anon., *Time*, 46, 29 (August 20, 1945), "Atomic Age."

(6) Rose, H. E., *Wall Street Journal CXXVI*, No. 14, 8 (1945), "Use of Diesel Oil Triples as Ships, Trains, Buses and Trucks Burn More and More."

All over The World

...Post-war plans are calling for *More* Furfural Refining *More* Solvent Dewaxing

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of necessity, began to stand on its own as a member of the fuel oil family. Now (July), wholesale prices of Diesel oil are about the same as those for domestic heating oils—$2.78 a barrel in New York harbor. In the Southwest, however, Diesel oils sell for slightly more than heating oils.

"One element in the postwar price picture will be the establishment of storage and delivery facilities for Diesel oils. As more trucks and buses are equipped with Diesel engines, the oil industry will be compelled to employ the 'service station' idea to supply them. These costs will also be passed along to the consumer through a higher price."(6)

Another future cost factor, often overlooked, is that, in 46 states, Diesel fuels are taxable as gasoline when used for roadway vehicles, with rates ranging from two to eight cents per gal. Up to now, however, this tax has seldom been collected, because of the small number of Diesel-powered road vehicles, but such will not be the case should retail sales reach a high volume.

Refinery prices may also increase. These formerly were determined on a by-product basis and averaged between 2.5 and 4 cents per gallon from 1935 to 1940, compared with regular-grade gasoline prices of 4-6 cents during recent years.

Diesel oil fractions will continue in heavy demand as catalytic cracking charge stocks, which means that the refiner must continue to choose between octane number (of gasolines) and cetane number (of Diesel fuels). Fortunately, the paraffinic, straight-run gas oils are inferior to naphthenic oils as catalytic cracking feed stocks, although superior as Diesel fuels. Segregation of these paraffinic oils for Diesel use will help, but the quantity available is insufficient.

Naphthenic gas oils and gas oils from thermal cracking have had to be used as Diesel fuels in the past, even though their cetane numbers are often too low for modern, high-speed Diesel engines. Moreover, there seems no alternative but to use such fuels (and gas oils from catalytic cracking) in the future, unless (as is very unlikely) Synthine Diesel fuels can be produced in quantity.(7) Ignition qualities can be improved by solvent extraction, hydrogenation, or the use of additives, but all these add to the cost.

It would seem that "engines, therefore, must be designed to accommodate the limitations of the fuel, instead of attempting to adjust the fuels beyond reasonable limits to suit engines."(8) Whether or not this will be done remains to be seen.

Increased Diesel oil demands are expected to come "from a greatly-expanded use of the engines by railroads, seagoing craft, public utilities, buses, trucks, and stationary power units for manufacturing concerns. The proportion of increase is expected to be greater for buses and trucks because of the Diesel economy in their operation. * * * *

"Outside this country, a huge demand is also anticipated by makers of stationary Diesels in the U. S. for rehabilitation of European industry, and substantially increased industrialization of Europe, South America, and China. Use of Diesel engines in passenger cars and smaller trucks is another (but lesser) postwar possibility."(6)

As for all materials when they leave the status of a by-product, the petroleum industry faces serious problems in regard to the production of increased quantities of Diesel fuels of suitable quality at prices low enough to stimulate continued growth. Higher prices seem inevitable, as stated, but these must be minimized through proper refinery balance and research.

Carbon Black

The petroleum industry has been relieved to learn that the serious shortage of carbon blacks, which threatened in the spring to impair tire quality and limit tire production,(9) has now been substantially eliminated, especially since the end of the war has brought a halt to the heavy demand for large tires for "expendable" military purposes.

Statistical releases prior to VJ-Day have been somewhat invalidated by such subsequent acts as the end of the use of sweet natural gas at several Texas plants and the cancellation by WPB of several authorized projects, but it still appears that production and consumption will be in reasonable balance. In August, for example, pre-VJ-Day estimates called for the production of 101,900,000 pounds of all grades of carbon black and the consumption of 95,100,000 pounds. Not all grades were provided in the desired quantities, but substitutes were available.

A recent survey(10) by a Bureau of Mines economist presents some interesting estimates for the next five years. Basing his figures on an average world consumption of all elastomers of 1,500,000 long tons per year, of which, in the first year, some 800,000 long tons will be synthetic rubber, Lott predicts a world demand for 1,182,000,000 pounds of carbon black in the first postwar year for use in rubber compounding (100,000,000 pounds for use in reclaimed rubber).

The predicted five-year average is 1,084,000,000 pounds, lower than the first year figure because Lott expects annual synthetic rubber use to decline to 400,000 tons by the end of the five-year period and to average 600,000 tons during that period. Non-rubber uses for carbon blacks bring the total demand estimates to 1,234,000,000 pounds for the first year and to 1,140,000,000 pounds as an average for the five-year period.

All of these figures are based upon an estimate that 950 pounds of carbon black will be used per ton of synthetic rubber and 460 pounds per ton of natural rubber. In prewar days, U. S. carbon black producers supplied most of the foreign as well as domestic demand, so that "to the extent that foreign production of carbon black increases, the demand from United States sources will be lessened."

It was anticipated, prior to VJ-Day, that "the total productive capacity of the carbon black industry in the U. S. at the end of 1945 may reach 1,450,000,000 pounds, of which about 200,000,000 pounds will represent Government-owned channel-plant facilities. An additional indeterminate portion of the total will fall into the emergency high-cost category, supplying the (then) swollen demands of war but destined to cease production upon the return of normal competitive conditions. * * * *

"Information currently available indicates that the return to large use of natural rubber will increase the demand for channel black, although its fields of application may be narrowed (as compared with the prewar period) by the availability of suitable furnace blacks at competitive costs. Higher future costs for gas at channel plants, which appear to be in prospect, would operate to the competitive disadvantage of those plants because of the low-product yields. The principal furnace grades may therefore have the advantage of lower unit production costs which would encourage their substitution for channel blacks, on a price basis, for many purposes for which the two types of black are more or less interchangeable on a quality basis."

(7) Anon., *NATIONAL PETROLEUM NEWS, Technical Section*, 36, No. 36, R-585 (1944), *"Keeping Up With the News—Diesel Fuels From the Synthine Process."*

(8) Hunter, B. F., *Diesel Power* 23, No. 8, 955 (1945), "Diesel Fuels."

(9) Anon., *NATIONAL PETROLEUM NEWS, Technical Section*, 37, No. 18, R-363 (1945), "Keeping Up With the News—Carbon Black."

(10) Lott, F. S., *Carbon Black—Current and Postwar Outlook*, Bureau of Mines Mineral Market Report No. MMS 1322 (Washington), July 20, 1945.

Fourth Instalment

P.A.W. Refinery Inspection Manual

Part 1—Process Equipment (Concluded)

Methods of repair for use by refinery maintenance crews when defects have been found as the result of inspection of processing equipment are presented in this instalment of the P.A.W. "Wartime Recommendations for Refinery Inspections". The importance of complete records is also discussed and many types of inspection records are illustrated.

This instalment concludes Part 1 (Process Equipment) of the Inspection Manual. Part 2 (Electrical Equipment) will start in the Nov. 7th Technical Section. Parts 3 (Instruments) and 4 (Fire Protection Equipment) will appear in later issues.

The inspection manual was originally prepared for the refineries in the wartime program by a group of P.A.W. and refining company engineers. It is being published in the NPN Technical Section by arrangement with the P.A.W. to make this valuable data available to refinery operators in general.

SECTION 5—Methods of Repair

151. General

In the following an attempt has been made to outline some of the more common methods of repair that are usually encountered in the course of inspections. Any methods used for repairing equipment should develop a strength equal to that required for the operating conditions. Care should be taken that the repair does not cause weakening of other parts of the equipment being repaired and must not set up internal stresses in the equipment. Makeshift or temporary repairs should never be made when there is any possibility that failure would result in a fire or in injury to personnel.

152. Safety Permits

Before starting any mechanical work a written safety permit should be obtained, signed by responsible authorities and outlining the type of work permissible. (See paragraph 123.02)

153 Vessels—Lined and Unlined

153.01—Methods for Repairing Cracks When cracks are encountered and repairs are made, any method adopted must be such as to prevent further progression of the crack. This can be accomplished by drilling holes at each end of the crack, but when this is done, it should be positively determined that the crack does not extend as a hairline through the holes which are drilled. A preferable method is to entirely remove the metal on each side of the crack beyond the visible ends, grinding the surface at the ends to a smooth finish with a rounded contour, and then etching to determine that the crack is entirely eliminated.

When repairs are made by chipping out the crack and filling up with weld metal, care should be taken that the weld is sound and of equal quality to welds in the joint of the vessel. Such repairs should be stress relieved locally, if the vessel was originally stress relieved, or the allowable pressure and minimum allowable thickness should be recomputed to conform to safe limits of a vessel that has not been stress relieved.

If the welded area is of appreciable length, it is advisable to remove a sample by trepanning to determine the soundness of the weld. If portable X-raying apparatus is available, it would be preferable to X-ray the entire repair. When riveted patches are used to cover the area where a crack has occurred, the efficiency at the rivet lines should be computed by a competent designer to assure that the joint between the patch and the wall of the vessel is equally as strong and has as high an efficiency as the corresponding vessel seam.

153.02—Repairs to Corroded Sections. If a corroded section is cut out of the vessel and replaced, the same procedure should be followed as for repairing cracks, paragraph 153.01. Small localized corroded areas may be repaired by building up with weld metal.

153.03—Deteriorated Rivet Heads. Deteriorated rivet heads, which are still of sufficient thickness to maintain the grip of the rivet, can be built up by welding to provide additional material to withstand corrosion. When this is done, all rivets which have been welded and those adjoining should be recaulked. All seams in the vicinity of welded rivets should also be recaulked, unless they are caulk welded.

When the remaining head is not sufficient to maintain the grip of the rivet, the rivets should be removed and replaced with new ones. It will generally be found that, when such rivets are removed, there is a raised collar around the edge of the rivet hole where the vessel wall metal has been protected against corrosion by the rivet head. This collar should be removed by spot facing or other means to assure satisfactory contact between the new rivet head and the vessel wall.

153.04 — Deteriorated Attachments (Nozzles, Manheads, Handholes, etc.). When attachments to vessels are replaced, the new ones should develop the strength required by the governing pressure vessel code. If reinforcing plates were used in connection with the old attachment, reinforcing plates of the same size and thickness as the original should be used when making the replacement. In the case of welded attachments, they should be locally stress relieved, if the vessel was originally stress relieved, or the allowable pressure and minimum allowable thickness should be recomputed to conform to safe limits of a vessel that has not been stress relieved.

153.05—Manhead and Handhole Gasket Replacement. When other than full-face gaskets are used, the bolt load necessary to secure a satisfactory gasket unit pressure enters into the computation of the thickness of the flange and cover plates. The satisfactory unit load varies with the gasket material. For these reasons, gaskets should always be replaced with others of the same material and size as the gaskets originally used. If it is felt necessary to use gaskets of other material or size, the flanges, cover plates and bolts should be recomputed to assure that they are strong enough for the new conditions.

153.06—Bolt Replacements. When deteriorated bolts are replaced, care should be taken that the new bolts have the same strength as the original bolts under the prevailing temperature conditions.

153.07—Closure of Inspection Test Holes. Test holes drilled completely through the wall of a vessel may be closed by completely filling the opening with weld material, by threading with a parallel thread and screwing in a threaded plug, seal welding the plug on the outside to the vessel wall or by threading the opening with a taper thread and screwing in a taper threaded plug until tight without seal welding. Care should be taken when using either type of threaded plug that they terminate flush with the inside wall of the vessel.

153.08—Hydrostatic Test After Re-

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pairs. After any major repairs are made, such as repairing cracks, corroded sections, deteriorated rivet heads, replacing rivets, or deteriorated attachments, it is advisable to apply a hydrostatic test, the pressure used being one and one-half times the allowable working pressure of the vessel computed on the basis of no corrosion allowance.

154. Shell and Tube Equipment

154.01—Shell and Channels. Repairs to these parts of shell and tube equipment are the same as those applying to vessels.

154.02—Tube Bundle. When only a small percentage of the tubes are found deteriorated to a point where leakage occurs, they may be plugged off by driving tapered plugs into each end of the tubes concerned. When it is necessary to replace tubes, the tube holes in the tube sheets should be carefully cleaned to assure good seating surface. They should also be checked for out-of-roundness, since it is almost impossible to get a tube tight in an elliptical hole.

If it is desired to use tubes of other material than those originally furnished, it should be ascertained that the new material is suitable for both the operating and corrosion conditions involved.

If the bundle is of the floating tube sheet type and is completely retubed, care should be taken to see that the bundle is not made up so long as to leave insufficient clearance between the floating tube sheet cover and the end of the shell to allow for expansion.

Before reinstalling tube bundles in the shell, the gasket surfaces of the tube sheets and other parts should be carefully checked to see that they are not corroded. If corroded areas are found, they should be built up by welding or brazing and then ground smooth and to the proper contour. After major repairs have been made to a tube bundle, it is advisable to apply a hydrostatic test to the bundle at a pressure equal to one and one-half times the allowable operating pressure.

155. Pipe, Valves and Fittings

155.01—Field Repairs. Field repairs to pipe, valves and fittings usually consist of replacement of the deteriorated material. Care should be taken that all replacements are made with material of the same pressure and temperature rating as that which was originally installed. If replacement of pipe is made with pipe of a substantially heavier wall or of a different material, having a different coefficient of expansion from that of the pipe originally used, a competent designer should check to see that the provision for expansion is sufficient.

156. Header Tubes

156.01—General. When it is necessary to reroll tubes due to leakage at the header tube hole, care should be taken that they are not rolled so far as to cause excessive thinning of the tube wall. When tubes are replaced, the new ones should be of a material and thickness suitable for the pressure and temperature conditions involved. When tubes are renewed, it is advisable to apply a hydrostatic test equal to a pressure equal to one and one-half times the allowable operating pressure.

157. Headers or Return Bends

157.01—Cracks. When cracks are found in header or return bends and do not extend entirely through the wall, the cracks should be chipped out until entirely removed. If sufficient material for strength remains after removal of the crack, the bottom and edges of the chipped area should be carefully rounded and smoothed and no other repairs are necessary. If sufficient material for strength does not remain after removal of the crack, the chipped area should be filled with weld.

When doing this welding, the rod should be of a material suitable for welding the material of which the box is made. Care should be taken in welding not to set up excessive welding stresses. Since it is usually not feasible to stress relieve such welds, adequate peaning after the placement of each welding layer is advisable to mechanically relieve as much stress as possible. Repairs by welding on boxes made of material which will air harden when heated should never be made unless the header box can be completely reheat treated after welding.

158. Tanks

The same methods of repair apply to tanks as to vessels, although probably to a somewhat lesser extent. The hydrostatic test called for under "Vessels" is not required on tanks. API Std. 12-A Specification for Standard Tanks with Riveted Shells, and API Std. 12-C Specification on All-Welded Oil Storage Tanks cover good tank construction and might well be followed when making repairs.

159. Cast Iron Equipment

Generally, the only repairs that can be made to cast iron equipment are by brazing. It is not advisable to make repairs by this method on parts under stress where failure would result in fire or injury to personnel. Care should also be taken that brazing repairs are not made where temperature conditions would soften the brazing material.

1510. Safety Or Relief Valves

1510.01—General. The most common repairs to safety or relief valves are such as are required to prevent leakage between the seat and disc. Safety valve manufacturers usually will supply complete written instructions covering the care and maintenance of their valves and it is recommended that such instructions be obtained and carefully followed.

1510.02—Seats and Discs. To obtain tightness, seats and discs are usually ground. In the case of flat seated valves,

this is usually done by lapping the seat and the disc independently. In the case of taper seated valves, it is usually done by grinding the two surfaces together, using a suitable grinding compound. Care should be taken when grinding that the seating surfaces do not become excessively wide. When excessively wide seating surfaces are found, they should be remachined.

In remachining seating surfaces, care should be taken to obtain the same contours and dimensions as originally used by the manufacturer. The relation of the seating surface to any other part of the seat or disc should be carefully maintained, as relatively small changes may affect either the action or capacity of the valve to a considerable extent. On tapered seat valves, there is generally a slight difference in angle between the machining of the seat and the machining of the contact surface on the disc. This should be maintained in remachining so that, when the two parts are ground together, a narrow seating surface can be obtained.

1510.03—Springs. Proper springs, as recommended by the manufacturer, should always be used and in no case should springs be used at pressure more than 10% below the minimum or more than 10% above the maximum recommended by the manufacturer. Some manufacturers will furnish spring lists for the various types and sizes of valves which the user may have in his plant, thus enabling him to check his springs to assure that they are proper for the setting and to order the proper new springs in case it is desired to change the setting of the valves.

1510.04—Adjustment. Where adjusting rings are used to control the action or amount of blowdown of a valve, they should be readjusted to the same relative position as originally set by the manufacturer.

1511. Pumps And Compressors

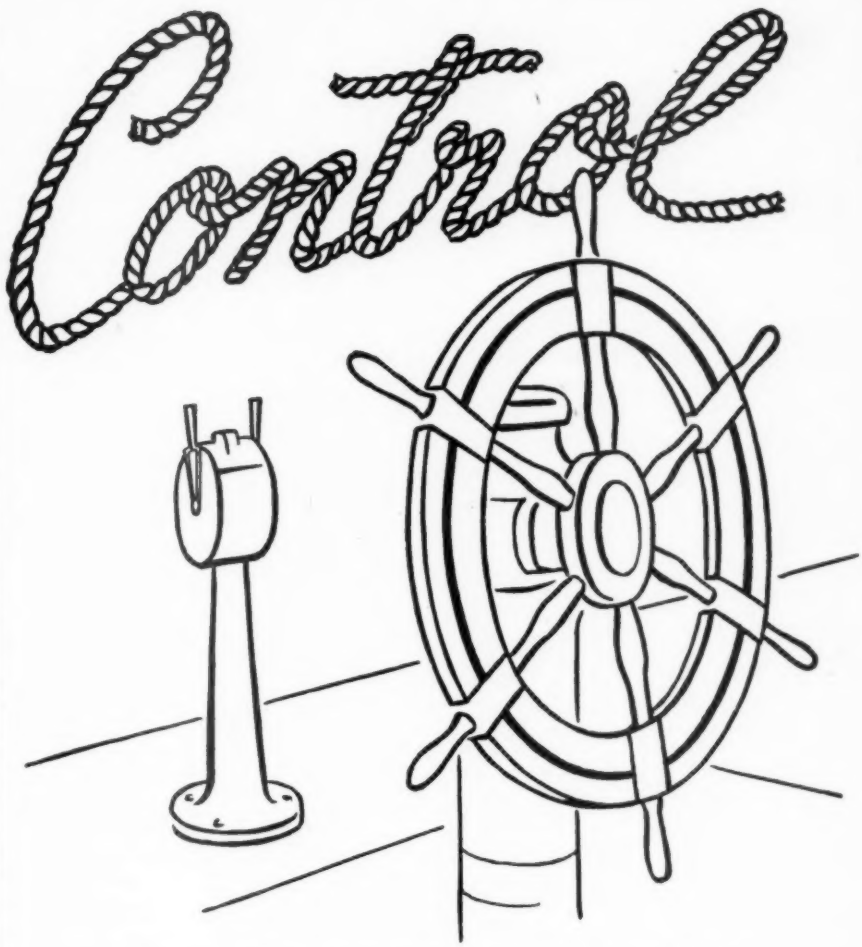
Pumps and compressors are so generally used and repaired by the user that no special comment is necessary other than a warning that only machinists experienced on this type of work should be allowed to make repairs.

SECTION 6—Records and Reports

161. Records

161.01 — Necessity. Results of inspection should be recorded in detail and kept in an orderly manner so that:—

161.01(a) Evaluation of Service Life. Some evaluation of service life may be placed on any line, tube, vessel, or piece of equipment in the plant. This information, in turn, may be coordinated with the Engineering Department, whereby changes may be specified in design or material which will help to



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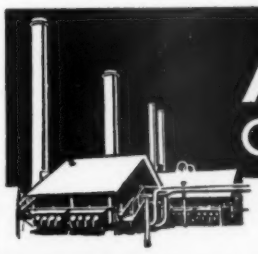

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STILL NO._____
REFINERY_____
CALIBRATED BY_____ DATE_____

FOR LOCATION OF CALIBRATION POINTS "A, B & C" SEE SKETCH BELOW.

TUBE NO.	MAT'L	TOP INS. DIA. CALIBRATIONS A	B	C	HOURS IN SERVICE	BOTTOM INS. DIA. CALIBRATIONS A	B	C	REMARKS	TUBE NO.	MAT'L	TOP INS. DIA. CALIBRATIONS A	B	C	HOURS IN SERVICE	BOTTOM INS. DIA. CALIBRATIONS A	B	C	REMARKS

REPLACEMENT TUBE CALIBRATIONS

TUBE NO.	MAT'L	CALIBR. POINT "A" TOP	BOTTOM	CALIBR. POINT "B" (OF LINERS ONLY) TOP	BOTTOM	CALIBR. POINT "C" TOP	BOTTOM	TUBE NO.	MAT'L	CALIBR. POINT "A" TOP	BOTTOM	CALIBR. POINT "B" (OF LINERS ONLY) TOP	BOTTOM	CALIBR. POINT "C" TOP	BOTTOM

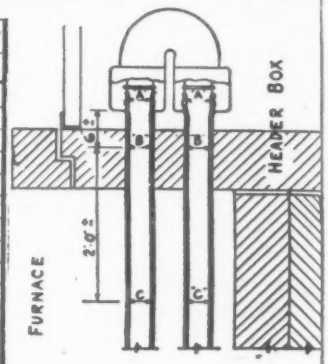


Fig. 24—Forms for tube calibration record for heating element

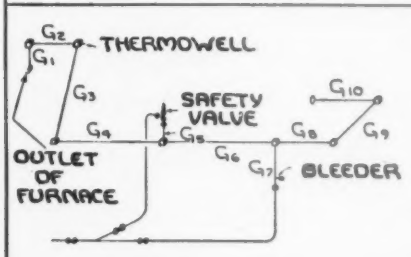
eliminate such failures as those which have occurred in the past.

161.01(b) Production Scheduling. A comprehensive picture of the general conditions of the entire plant may be first-hand information, which will enable the Operating Department to plan shut-down periods to fit in with the production schedule, thereby maintaining proper refinery balance.

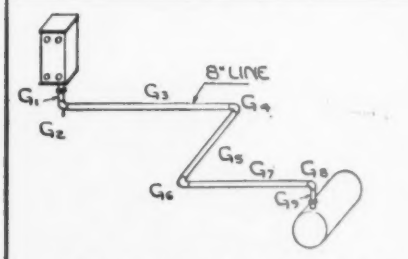
161.01(c) Investigations or Discussions. A permanent record will be available at all times as proof of inspection or inspections in case the management, an outside agency or insurance company requests them for review, discussion or investigation.

161.02—What to Record. After a complete inspection of the lines, tubes, vessels and allied equipment, it is advisable to prepare the following records:

LOCATION OF LINES AND EQUIPMENT



TYPICAL SKETCH OF SECTION OF HIGH PRESS. LINE



TYPICAL SKETCH OF LOW PRESS. LINES

WALL THICKNESS OF LINES AS GAUGED

INSP. DATE	G_1 O.D.	I.D.	Thk.	G_2 O.D.	I.D.	Thk.	G_3 O.D.	I.D.	Thk.	G_4 O.D.	I.D.	Thk.	G_5 O.D.	I.D.	Thk.	G_6 O.D.	I.D.	Thk.	G_7 O.D.	I.D.	Thk.	G_8 O.D.	I.D.	Thk.	G_9 O.D.	I.D.	Thk.	G_{10} O.D.	I.D.	Thk.	TEST PRESS. #/□"
Orig.	4 3/4"	3 1/2"	7/8"	4 3/4"	3 1/2"	7/8"	4 3/4"	3 1/2"	7/8"	4 3/4"	3 1/2"	7/8"	3 1/2"	2 1/2"	1/2"	4 3/4"	3 1/2"	7/8"	4 3/4"	3 1/2"	7/8"	4 3/4"	3 1/2"	7/8"	4 3/4"	3 1/2"	7/8"	4 3/4"	3 1/2"	7/8"	2000
8-10-38	4 3/4"	3 3/4"	7/32"	4 3/4"	3 3/4"	7/32"	4 3/4"	3 3/4"	7/32"	4 3/4"	3 5/8"	17/32"	3 1/2"	2 1/4"	7/32"	4 3/4"	3 3/4"	7/32"	4 3/4"	3 5/8"	7/16"	4 3/4"	3 5/8"	7/16"	4 3/4"	3 3/4"	7/32"	4 3/4"	3 3/4"	7/32"	"
10-6-38	4 3/4"	3 5/8"	7/16"	4 3/4"	3 7/16"	15/32"	4 3/4"	3 5/8"	7/16"	Renewed			3 1/2"	2 1/16"	9/32"	4 3/4"	3 5/8"	7/16"	4 3/4"	3 7/16"	1/2"	4 3/4"	3 3/4"	1/2"	Renewed			4 3/4"	3 1/16"	15/32"	"
7-3-39	4 3/4"	3 7/16"	17/32"	Renewed			Renewed			4 3/4"	3 5/8"	7/16"	Renewed			4 3/4"	3 3/4"	1/2"	4 3/4"	3 13/16"	17/32"	4 3/4"	3 5/8"	7/16"	4 3/4"	3 5/8"	7/16"	4 3/4"	3 1/16"	15/32"	"
11-12-40	4 3/4"	3 5/8"	1/2"	4 3/4"	3 5/8"	1/2"	4 3/4"	3 7/16"	17/32"	4 3/4"	3 7/16"	17/32"	3 1/2"	2 1/8"	7/16"	4 3/4"	3 7/8"	7/16"	4 3/4"	3 7/8"	7/16"	Renewed			4 3/4"	3 5/8"	1/2"	4 3/4"	3 1/16"	15/32"	"

NOTE -
THIS CHART SHOWS A TYPICAL METHOD OF RECORDING THE FINDINGS OBTAINED DURING THE PERIODIC INSPECTIONS AND SHOULD NOT BE USED FOR ESTABLISHING RETIRING LIMITS.

8-10-38	Hammer Test. ed O.K.			Hammer Test. ed O.K.			Hammer Test. ed O.K.			Renewed Hammer Test. ed O.K.			Hammer Test. ed O.K.			Hammer Tested Good condition			Hammer Tested Good condition			Hammered Tested Good condition								60
11-6-38	Renewed			"			"			"			Hammer Test. ed Good cond.			"			"			"			"			"		60
7-3-39	Hammer Test. ed O.K.			"			Renewed Hammer Test. ed O.K.			"			Renewed Hammer Test. ed Good cond.			"			"			"			"			"		60
11-12-40	"			Renewed			"			"			Thin and pitted Renewed			"			"			"			"			"		60

Fig. 25—Inspection record form for high and low pressure lines. (Note: Actual form provides space at right of sheet for remarks.)

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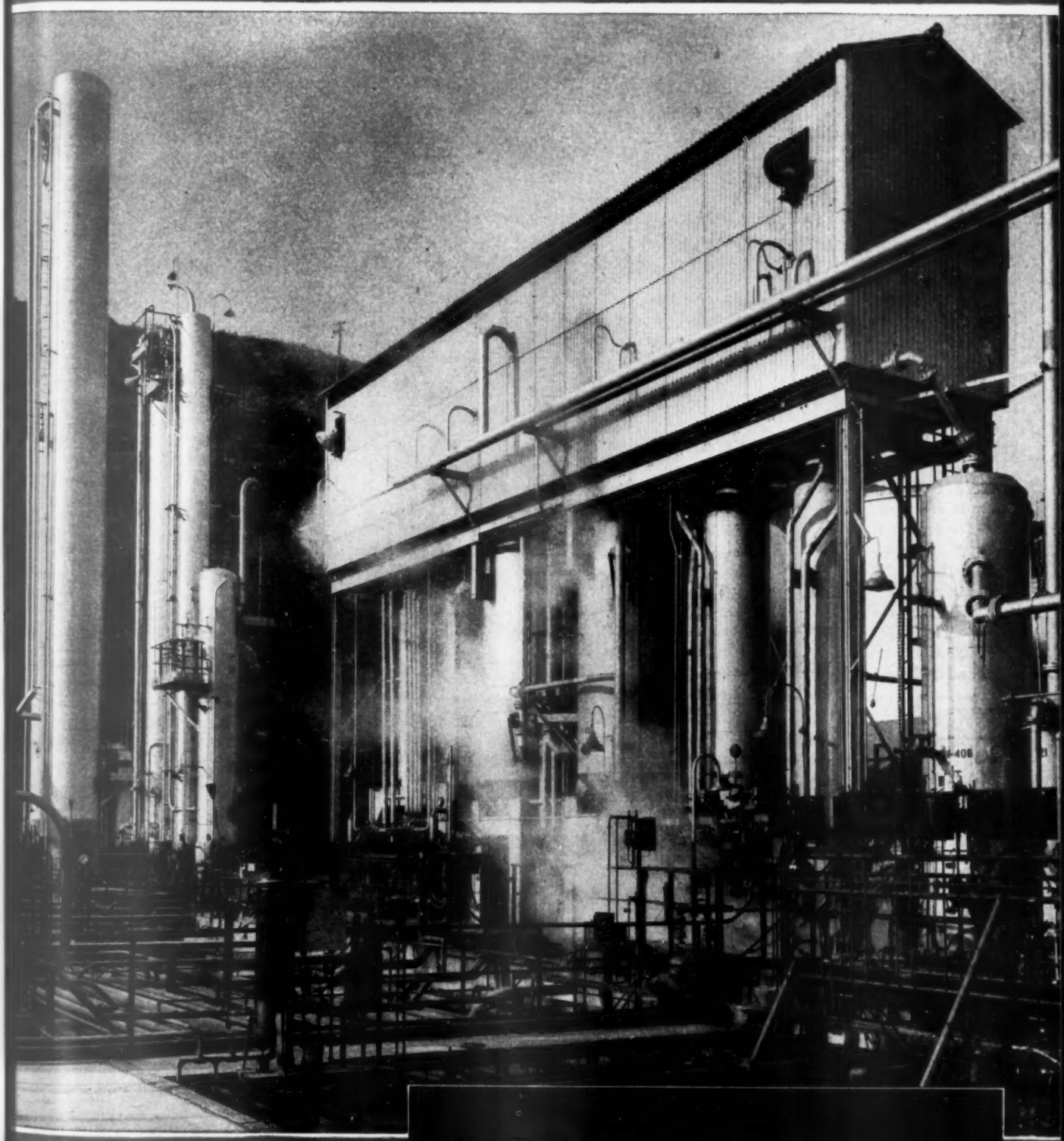

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The above is some of the valuable material included in the complete reprints of Part 1—Process Equipment—of the P.A.W. Refinery Inspection Manual; the concluding instalment of which is published in this issue of the NPN TECHNICAL SECTION. These reprints, now available, are bound in stiff paper covers and stapled, thus providing the sturdiness necessary for frequent handling, ready reference and regular use right on the job. Individual copies will be helpful to many men in the plant inspection crew.

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NOTE—The remaining three Parts of the Refinery Inspection Manual, by arrangement with P.A.W., will be published serially in the TECHNICAL SECTION of NPN. For the convenience of readers, each Part will be reprinted as a separate booklet. Orders may be placed now for any or all Parts of the Inspection Manual at the following prices, to be filled when the reprints are available:

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161.02(a) Piping. The date and location of any lines or sections of lines which were visually inspected, hammer tested or subjected to a hydrostatic test, also, hydrostatic test pressure and the procedure used in making the test, should be recorded.

161.02(b) Furnaces. The date, tube and roll gauges of all furnace or still tubes, together with notes covering the condition of the headers, header boxes and return bends, the tube and roll gauges of all tubes in the high pressure heat exchanger equipment with notes covering the condition of the plugs, headers, and return bends, should be recorded.

161.02(c) Vessels. Notes covering in detail the condition of any vessel as found by visual inspection, together with a complete record of any measurements which were taken to determine the shell thickness, and a brief outline describing any tests which were made on the vessel: e. g., strapping, trepanning or hydrostatic tests, should be recorded.

161.02(d) Changes. Detailed notes and adequate sketches to cover all repairs, replacements or changes which were recommended during the inspection should be recorded.

161.03—How to Record Data.

161.03(a) Filing. All detailed field inspection notes should be studied, transcribed and filed.

161.03(b) Check Lists. Check lists for different types of equipment, i.e. lines, valves, vessels, relief valves, etc. should be maintained to reduce the possibility of overlooking any point of inspection. In many cases these check lists can also carry all comparative data required.

161.04—Typical Forms. The question of how the inspection data should be set up lies finally with the individual in charge of making and keeping the records, and is governed primarily by the type and amount of equipment in the plant. Typical form for inspection records are shown in Figs. 9 and 10, Pg. R-690, Sept. 5, 1945, NPN Technical Section and in accompanying Figs. 24-33.

Figs. 24 and 25 are on page R-824
Figs. 26 and 27 are on page R-828
Figs. 28 and 29 are on page R-829
Figs. 30 and 31 are on page R-831
Figs. 32 and 33 are on page R-832

All forms referred to are for illustrative purposes to clarify the text. They do not represent a complete set of record forms and are not necessarily recommended for adoption. It is felt that each inspection force will have to develop the forms it needs and which best suit its own conditions.

162. Reports

162.01—Frequency of Issue. At the completion of each shut-down period a formal inspection report should be submitted to all interested parties.

162.02—What Should Be Covered. The report should be made to produce a composite picture of all the data which were assembled during the inspection. This should be in the form of a descriptive report covering points of special interest and predicting imminent renewal of parts so that material will be available to make repairs when required. As much detail data as may be of value to the parties receiving the report might be included.

162.03—Value of Reports. The reasons itemized under that section of the code which covers "The necessity for making and keeping reports" directly reflect the value of such records and reports. The value of these records, may be more fully realized when these data are coordinated with the maintenance department. They convey valuable information whereby the department head may order any necessary material for future replacements, plan and execute preliminary work and organize maintenance personnel for future shut-down periods. The net result, therefore, is to minimize emergency shut-downs and facilitate the work at the regular scheduled shut-downs.

SECTION 7—Tools

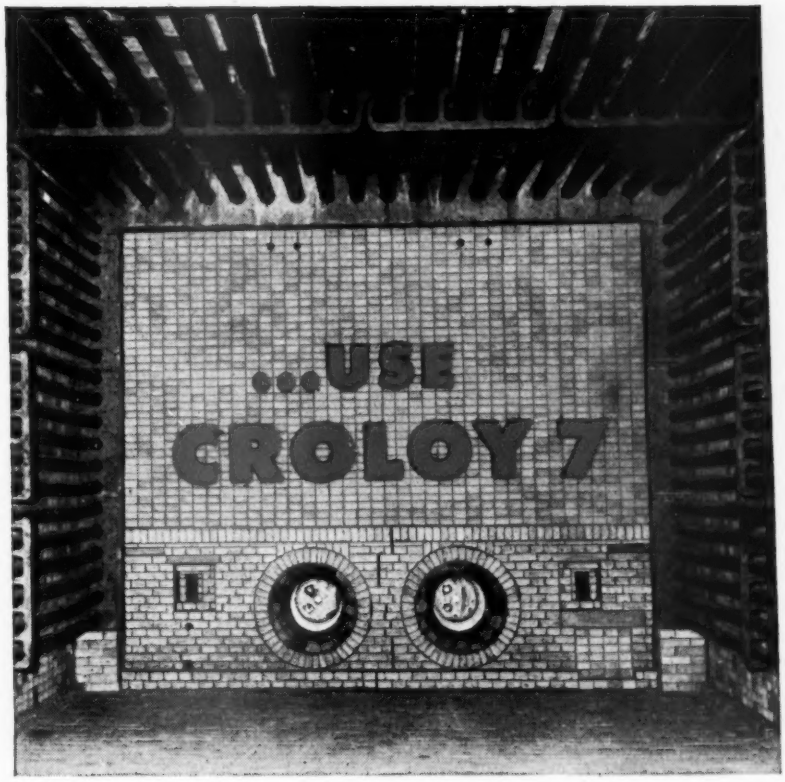
171. General

In order to ascertain the wall thickness of tubes, headers, tees, crosses and other fittings, it is necessary to develop such gauges as will enable the inspector to make these measurements accurately and quickly. The type of gauge, which will be necessary, therefore, will be governed entirely by the problems encountered in making these measurements. It is suggested that each individual company analyze these problems and develop in their own shops, or purchase, such gauges as will enable the inspector to do a thorough job

Detail drawings of a few typical tools appeared with the second installment in the Aug. 1 issue—Figs. 5, 6 and 8.

FOR

HIGHLY CORROSION-RESISTANT TUBING AT A SAVING . . .



TYPICAL TEST RESULTS

5000 hr. test at 750F, 1.25% sulphur charging stock in evaporation column of cracking unit. Average penetration:

.00025 in. per 1000 hrs.—Croloy 7
.00650 in. per 1000 hrs.—Croloy 5

921 hr. test in high sulphur West Texas crude. Penetration:

.0260 in. Total—Croloy 7
.0830 in. total—Croloy 5

2200 hr. test in soaker section of gas oil furnace at 900F. Weight loss:

1.83%—Croloy 7
3.95%—Croloy 5

OVER seven years' experience with Croloy 7 tubing in refinery processes leaves no doubt as to its time- and cost-saving advantages for combating corrosion due to hot oils and similarly severe conditions. Its use has meant fewer shutdowns for retubing, longer tube life, lower maintenance and greater continuity of war-vital production facilities.

Popularity of this intermediate alloy tubing—developed and introduced by B&W—is due to its ability to withstand corrosive attack much better than alloy tubing containing 5% Cr.—.50% Mo., yet it costs but little more. Thus Croloy 7 is widely known among users as the "economy tubing" where corrosion resistance is the chief requirement.

The accompanying comparative tests under actual service conditions show plainly why it will pay you to investigate the advantages of using this performance-proved B&W alloy tubing. Technical data on Croloy 7 will be supplied without obligation.

B&W TUBES

SEAMLESS. Complete range of carbon alloys and stainless steel.
Sizes: ½ in. to 8⅝ in. O.D.

ELECTRIC-Resistance Welded Carbon grades
Sizes: ¾ in. to 4 in. O.D.

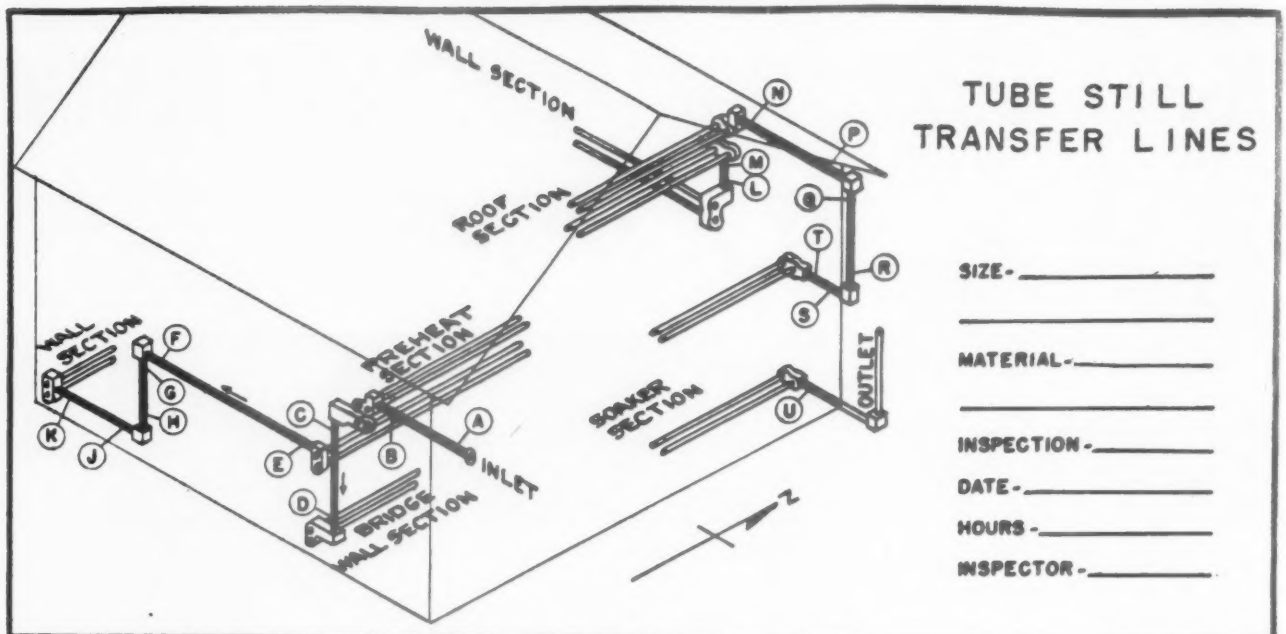
THE BABCOCK & WILCOX TUBE COMPANY

Seamless Tube Division
BEAVER FALLS, PA.

Welded Tube Division
ALLIANCE, OHIO

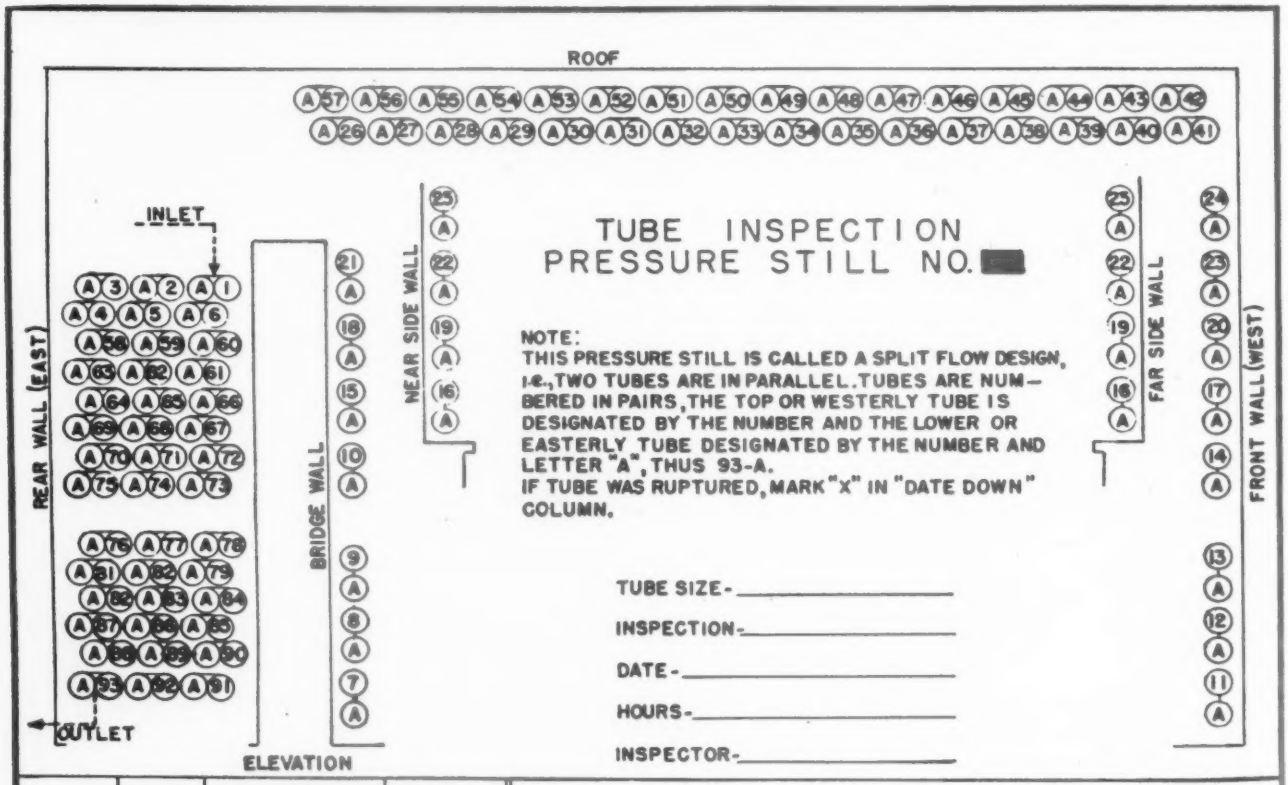
B&W MAKES BOTH

JA 1332



INSPEC. POINT	ITEM INSPECTED	NOMINAL SIZES		FIELD MEAS'MT.		RETIRE'T WALL THKS	REMAINING LIFE		REMARKS
		I.D.	WALL	MAX. I.D.	MIN. WALL		INCHES	HOURS	
A									
B									

Fig. 26—Inspection record form for tube still transfer lines (Note: Under Inspection Points space should also be provided for Headers, Gaskets, Bolting, Insulation and Supports)


ROOF
INLET
REAR WALL (EAST)
BRIDGE WALL
NEAR SIDE WALL
FAR SIDE WALL
FRONT WALL (WEST)
OUTLET
ELEVATION
TUBE INSPECTION
PRESSURE STILL NO.
NOTE:
THIS PRESSURE STILL IS CALLED A SPLIT FLOW DESIGN, i.e., TWO TUBES ARE IN PARALLEL. TUBES ARE NUMBERED IN PAIRS, THE TOP OR WESTERLY TUBE IS DESIGNATED BY THE NUMBER AND THE LOWER OR EASTERLY TUBE DESIGNATED BY THE NUMBER AND LETTER "A", THUS 93-A.
IF TUBE WAS RUPTURED, MARK "X" IN "DATE DOWN" COLUMN.
TUBE SIZE-
INSPECTION-
DATE-
HOURS-
INSPECTOR-

TUBE NO.	DATE DOWN	TUBE MATERIAL		HOURS ON STREAM	REMARKS
		OUT	IN		

Fig. 27—Inspection record form for pressure still tubes

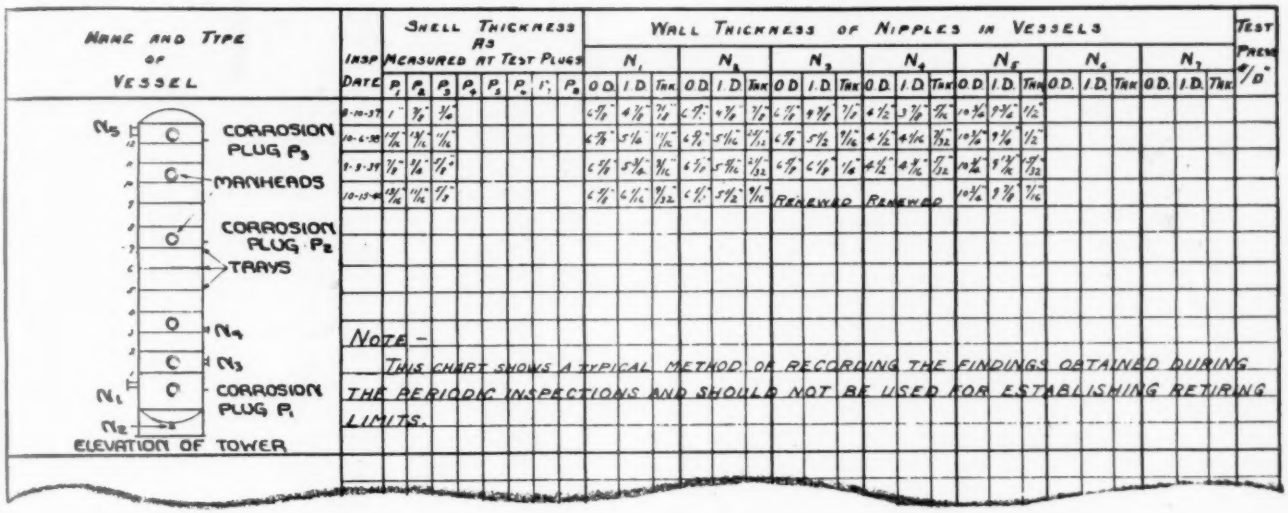

NAME AND TYPE OF VESSEL
SHELL THICKNESS AS MEASURED AT TEST PLUGS
WALL THICKNESS OF NIPPLES IN VESSELS
TEST PRESS #/□"
INSP DATE
P1 P2 P3 P4 P5 P6 P7 P8
N1 N2 N3 N4 N5 N6 N7
O.D. I.D. THK
9-10-37
10-6-38
9-9-39
10-13-40
RENEWED
RENEWED
CORROSION PLUG P3
MANHEADS
CORROSION PLUG P2
TRAYS
CORROSION PLUG P1
ELEVATION OF TOWER
NOTE –
THIS CHART SHOWS A TYPICAL METHOD OF RECORDING THE FINDINGS OBTAINED DURING THE PERIODIC INSPECTIONS AND SHOULD NOT BE USED FOR ESTABLISHING RETIRING LIMITS.

Fig. 28—Inspection record form for pressure vessels. (Note: Actual form provides space at right of sheet for remarks)

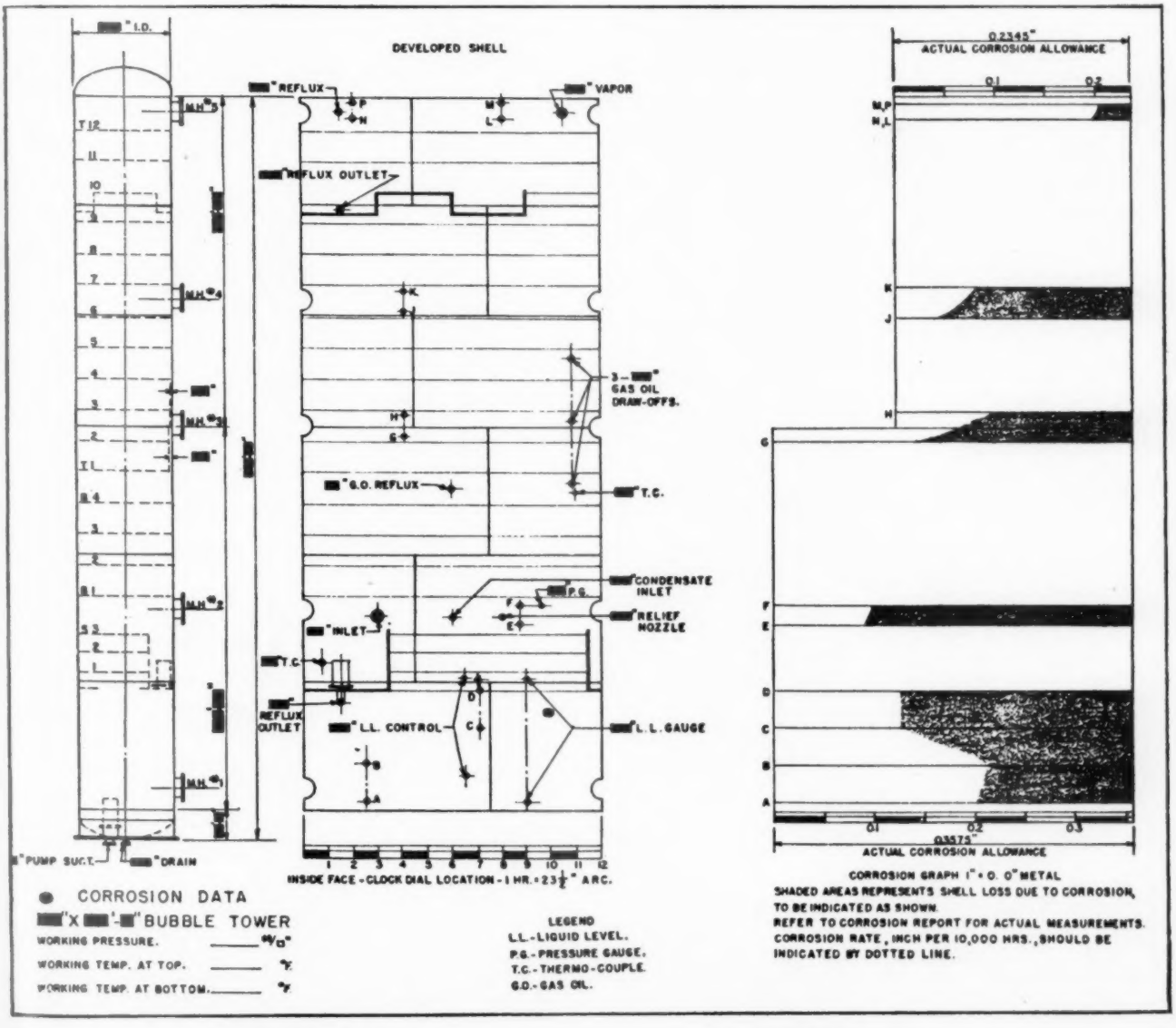
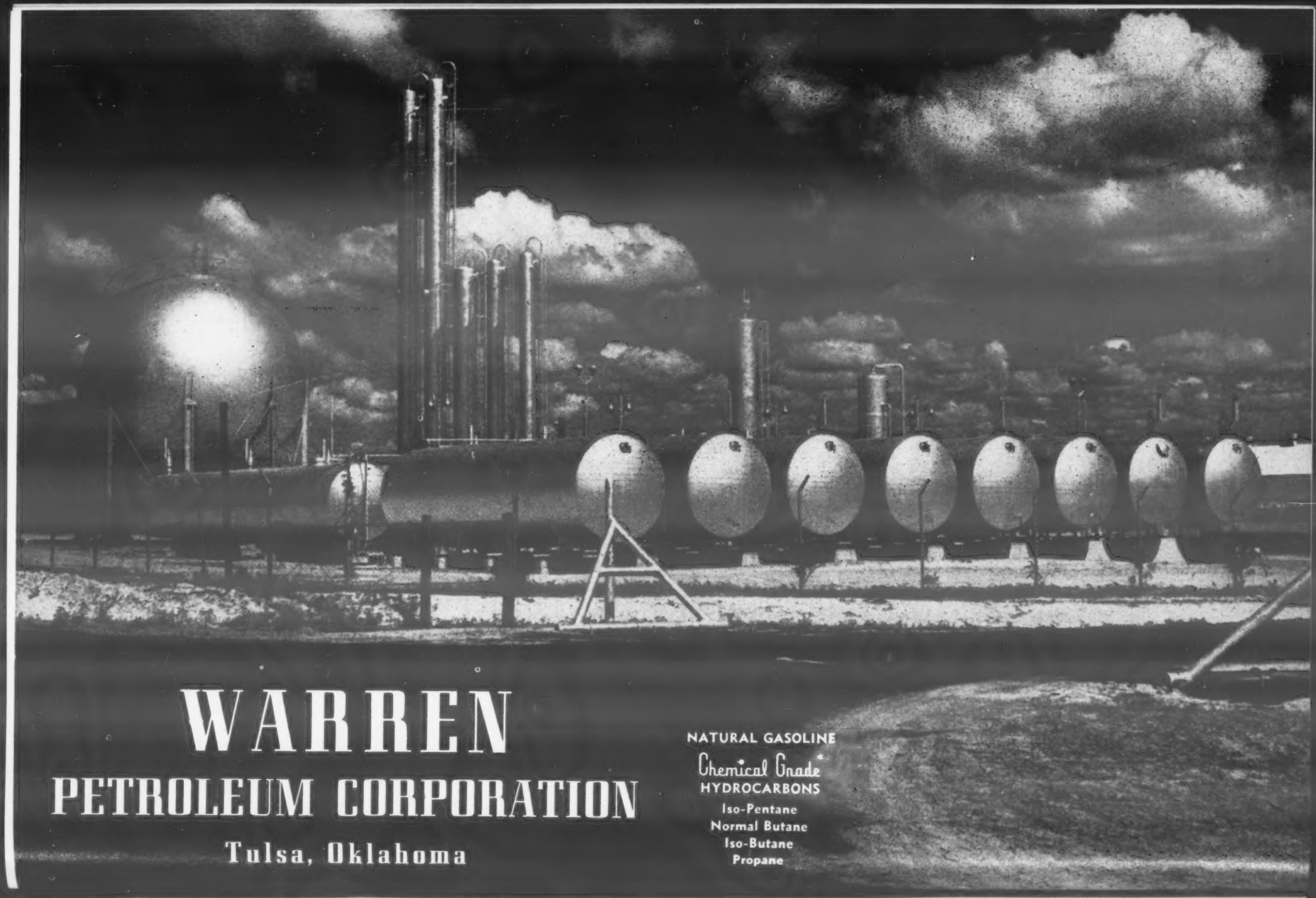
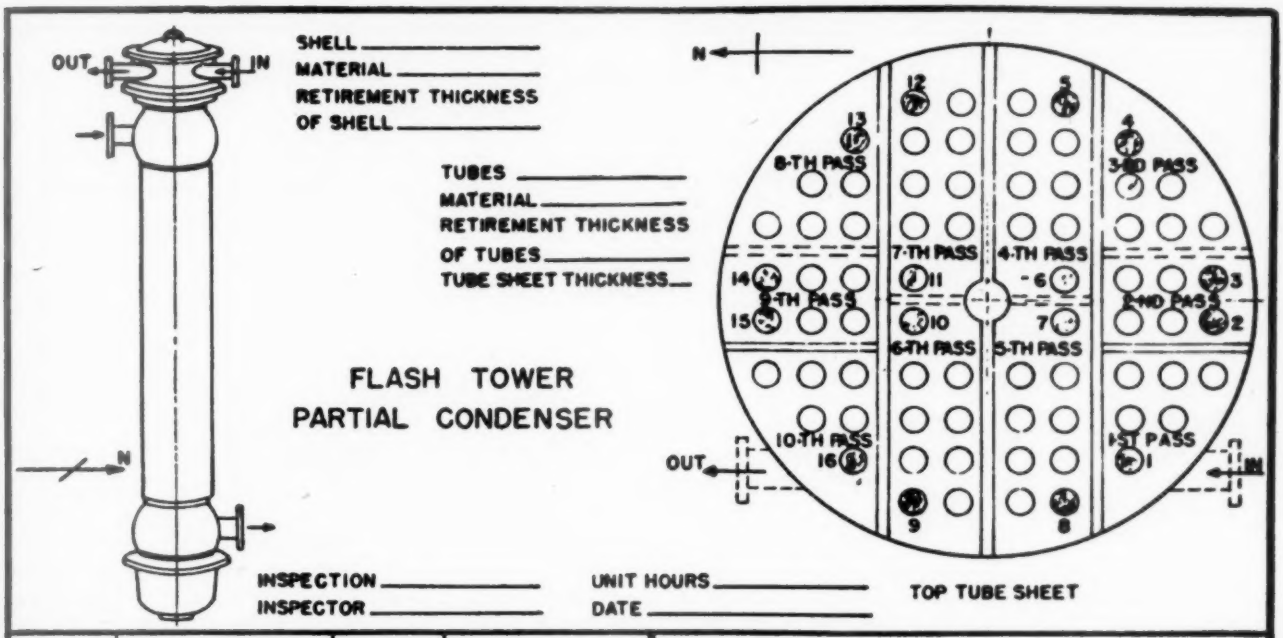


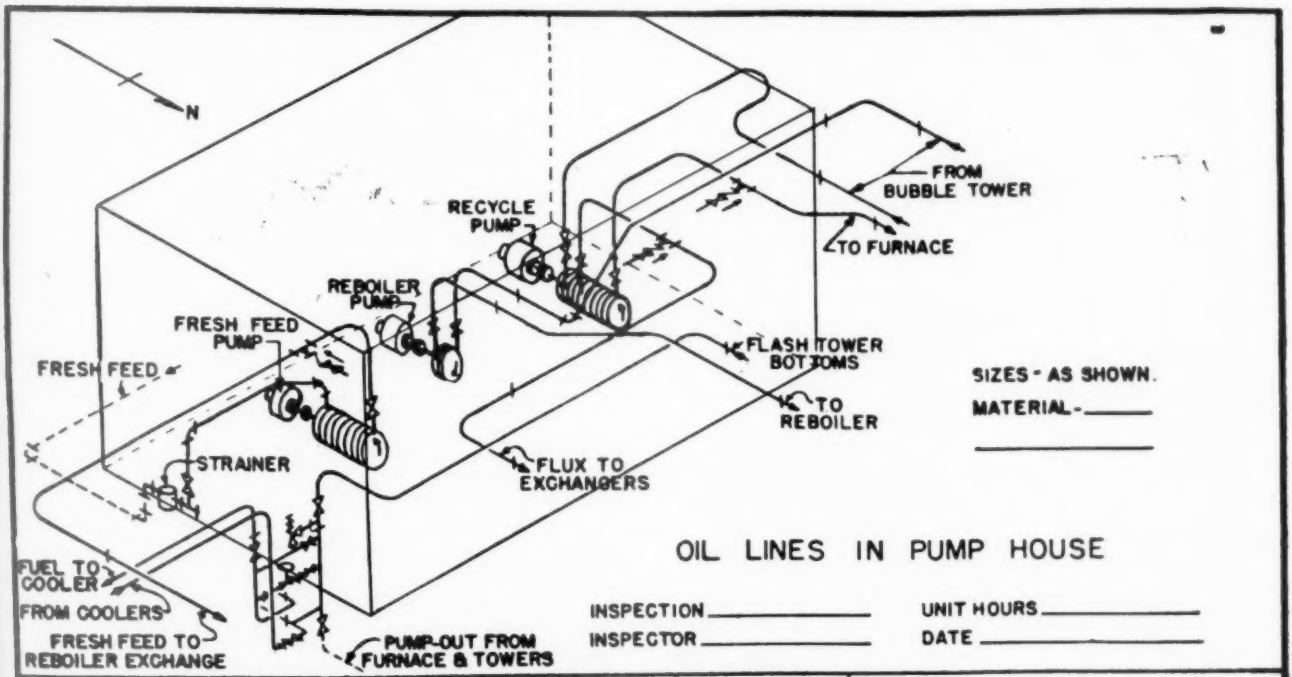
Fig. 29—Form for inspection record of corrosion data on bubble tower


WARREN
PETROLEUM CORPORATION
Tulsa, Oklahoma
NATURAL GASOLINE
Chemical Grade
HYDROCARBONS
Iso-Pentane
Normal Butane
Iso-Butane
Propane



INSPECTION POINT	FIELD MEASUREMENT		REMAINING WALL THICKNESS	REMAINING LIFE		REMARKS
	MIN. O.D.	MAX. I.D.		INCHES	HOURS	
1.						
2.						
3.						

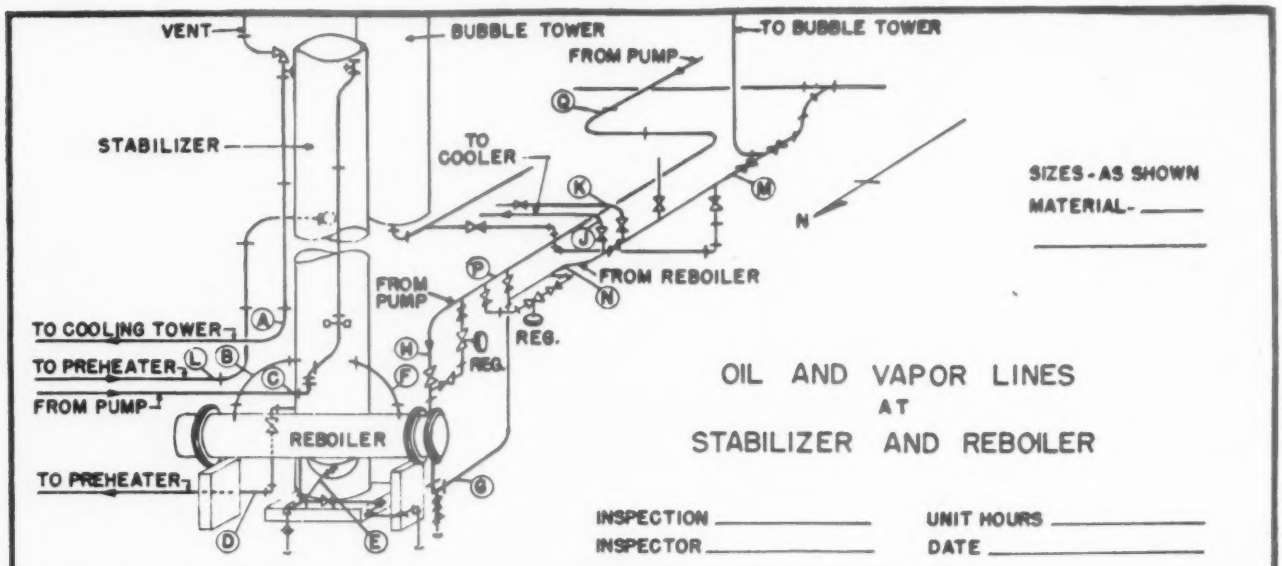
Fig. 30—Inspection record form for heat transfer equipment. (Note: Under Inspection Points space should also be provided for Heads, Tube Sheets, Shell and Nozzles)



INSPECTION POINT	ITEM INSPECTED	ORIGINAL DATA		FIELD MEASUREMENT		RETIREMENT WALL THICKNESS	REMAINING LIFE		REMARKS
		I.D.	WALL	MAX. I.D.	MIN. WALL		INCHES	HOURS	

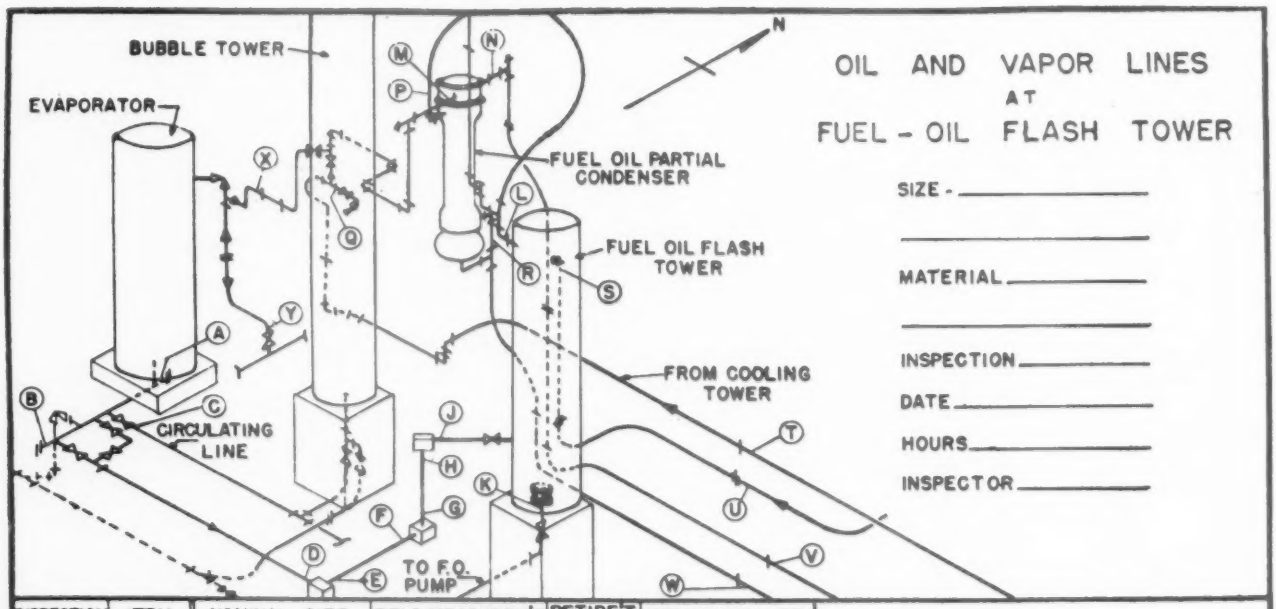
Fig. 31—Inspection record form for oil lines in pump house

Iso-Butane
Propane
Tulsa, Oklahoma



INSPECTION POINT	ITEM INSPECTED	NOMINAL SIZE		FIELD MEASUREM'T		RETIRE'T WALL THKS	REMAINING LIFE		REMARKS
		I.D.	WALL	MAX. I.D.	MIN. WALL		INCHES	HOURS	
A.									
B.									
C.									
D.									

Fig. 32—Inspection record form for oil and vapor lines for stabilizer and reboiler. (Note: Under Inspection Points space should also be provided for Supports and Valves)



INSPECTION POINT	ITEM INSPECT'D	NOMINAL SIZE		FIELD MEASUREM'T		RETIRE'T WALL THKS	REMAINING LIFE		REMARKS
		I.D.	WALL	MAX. I.D.	MIN. WALL		INCHES	HOURS	
A.									
B.									
C.									
D.									

Fig. 33—Inspection record form for oil and vapor lines at fuel oil flash tower. (Note: Under Inspection Points space should also be provided for Valves)

Patent Trends in Petroleum Refining

By Peter J. Gaylor

Direct Amination of Olefins

Sinclair Refining Co.'s recent announcement[1] of a process for producing amines and nitriles by reacting olefins with ammonia in presence of catalysts appears to be the culmination of many years of research. Very little data are available on previous processes of this type, although the I.G. have described the amination of ethylene to ethylamine in presence of reduced ammonium molybdate[2]. Lazier[3] prepared amines by reacting alcohols with ammonia, while Stadnikov[4] reported the production of aminobutyric acid from crotonic acid and ammonia at 130-140°C.

In the Sinclair patents just issued (U. S. 2,381,470-3 and 2,381,709), data are submitted indicating that the process still has some kinks which will have to be ironed out. Among these are the low percentage of reacted olefin per pass and the loss of olefin in side reactions such as polymerization and hydrogenation. Furthermore, there is no clean-cut reaction, so that a mixture of primary, secondary and tertiary amines are produced.

As the patents point out, the reaction involves direct addition of ammonia to the double bond of the olefin:

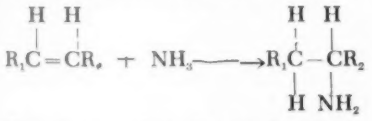


Fig. 1 is a relatively simple flowsheet of the process involved. Olefin and ammonia are delivered by pump 1 through line 2 to the preheating zone of the reaction chamber filled with stainless steel Raschig rings and having the upper portion electrically heated. The lower portion of the reactor contains the pelleted catalyst. After about 1½ hrs., the products are released from the reactor through line 4 (by opening valve 5), cooled in cooler 6 and run into receiver 7 from which the gas is released and product recovered.

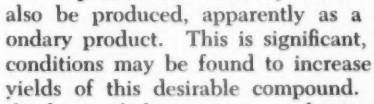
In one example, *n*-dodecene-1 is reacted with anhydrous ammonia in a 1:1.64 molar ratio in presence of an active unpromoted cobalt catalyst suspended on asbestos. The temperature of 500-550°F. is maintained for 20 hrs., the pressure being 2000 psi. Under these conditions, 50-60% of the olefin is consumed, the nitrogen compounds produced being about 12% of the weight of the olefin charged, or 20-25% of the olefin consumed. These nitrogen compounds are mainly lauryl amine, di-lauryl amine, lauronitrile and, in some cases, lauric acid amide. The disposition of the remaining olefin consumed may be followed from Table 1.

Little data are given for lower olefines, although one example specifies a refinery olefin mixture containing 35% olefins. In the production of propionitrile, using a 51.1% reduced Co catalyst, a 20.4% yield of nitrile (of the total nitration product) was obtained, the polymer being 2.5%.

Of the catalysts suitable for the reaction, the following are given as most desirable:

Catalyst	Promoter	Support
Fe_2O_4	K_2O and Al_2O_3	.....
Ni	.....	Asbestos
Ni	reduced Ni_2O_3	.....
Cu	.....	Al_2O_3
Cu	CuCrO	.....
Cu	MgO	MgO
Fe	.....	Asbestos
Co	ThO_2	Asbestos
Co	ThO_2	Al_2O_3
Co	Cr_2O_3	Al_2O_3

It is pointed out that acrylonitrile may also be produced, apparently as a secondary product. This is significant, and conditions may be found to increase the yields of this desirable compound. On the basis of the reaction mechanism involved here, one would think that acetylene would be the ideal raw material for producing this compound:



However, data in the literature[5] indicate that these two raw materials react only at very high temperatures, giving mostly pyridine base type products.

Diolefins

One interesting method recently covered by duPont (U. S. 2,381,038) involves the continuous production of diolefins by pyrolysis of chlorinated hydrocarbons. As illustrated in Fig. 2, the chlorinated hydrocarbons in tank 1 are first vaporized in vaporizer 2 and then decomposed in heated tube 3. The products are led into a preliminary condenser 4, thence into an absorption column 5 in which precooled chlorinated hydocarbons from 17 are employed to scrub the HCl which comes off the top of the tower at 8. The extract is subjected to another fractionation step at 10, at which point the diene pyrolysis products are drawn off the top at 12, while the chlorinated hydrocarbons are drawn

TABLE 1

Product	Wt. % Olefine Charge	Wt. % Olefine Consumed
Organic nitrogen	12	22.6
Paraffin	26	49.0
Polymers	10	19.0
Loss	5	9.4
Recycle olefin	47	...
	100	100.0

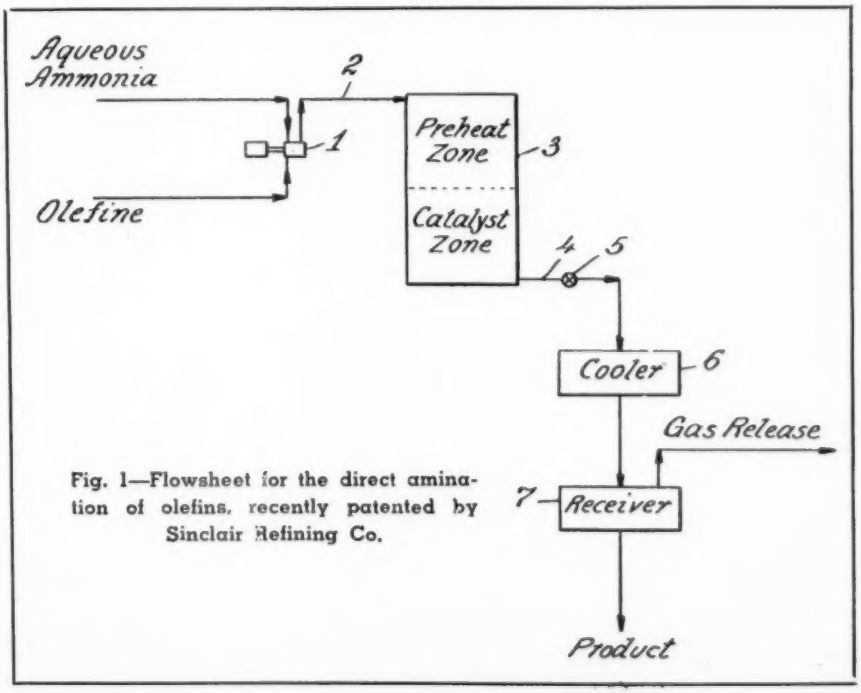


Fig. 1—Flowsheet for the direct amination of olefins, recently patented by Sinclair Refining Co.

Peter J. Gaylor is a patent attorney and editor of the Technical Survey, Newark, N. J.

off the bottom into tank 14 for recycling.

When 2,3-dichlorobutane is used as the raw material, pyrolysis at 650°C. by this method results in a yield of 0.8 mole 1:3 butadiene, 0.15 mole chlorbutadiene and 1.75 moles HCl per mole of dichlorbutane introduced. When using 2,2,3-trichlorobutane as raw material, 2-chloro-1,3-butadiene of polymerizable quality is produced in amounts of 0.6-0.7 mole/mole trichlorobutane, together with about 2 moles HCl.

Polysilicones from Petroleum

The G.E. patents (U. S. 2,258,218-22) which first disclosed the production of silicone polymers described the preparation of these valuable products as follows: Ether solutions of phenyl magnesium bromide and methyl magnesium bromide are reacted with silicon tetrachloride by heating under reflux for several hours, when the following reaction takes place:

$$C_6H_5MgBr + CH_3MgBr + SiCl_4 \longrightarrow C_6H_5\overset{CH_3}{\overset{|}{Si}}Cl_2 + 2MgBrCl$$

The mixture is then hydrolyzed by pouring over cracked ice, whereupon the following reaction ensues:

$$C_6H_5\overset{CH_3}{\overset{|}{Si}}Cl_2 + 2H_2O \longrightarrow C_6H_5\overset{CH_3}{\overset{|}{Si}}(OH)_2 + 2HCl$$

The silicols thus produced are washed with water and partly condensed to silicones. The condensation is in the nature of a polymerization in that the molecule grows larger as water is driven off with the formation of a material of the structure as follows:

$$HO\text{-}\overset{CH_3}{\overset{|}{Si}}\text{-}O\text{-}\overset{CH_3}{\overset{|}{Si}}\text{-}\cdots\text{-}O\text{-}\overset{CH_3}{\overset{|}{Si}}\text{-}OH$$
$$\quad\quad C_6H_5 \quad\quad\quad C_6H_5 \quad\quad\quad C_6H_5$$

The condensation and partial dehydration take place in toluene solution as the toluene is driven off at 120°C., followed by subsequent heating to 175°C.

The Montclair Research Corp. recently combined 10 of its patent applications into Brit. Appl. 7382/45 covering the direct production of organo silicon derivatives from hydrocarbon halides. The process involves reacting a silicon halide or oxyhalide with a Grignard reagent or with a halohydrocarbon such as an alkyl or aryl or aralkyl halide or mixtures of such halides in presence of metallic magnesium or lithium at refluxing temperature. The mole ratio of halohydrocarbon to silicon halide is equal to the ratio of the number of hydrocarbon groups to silicon in the desired organo silicon derivative. Such a process would provide a cheaper way of producing the organo-silicon halides shown in the first reaction above.

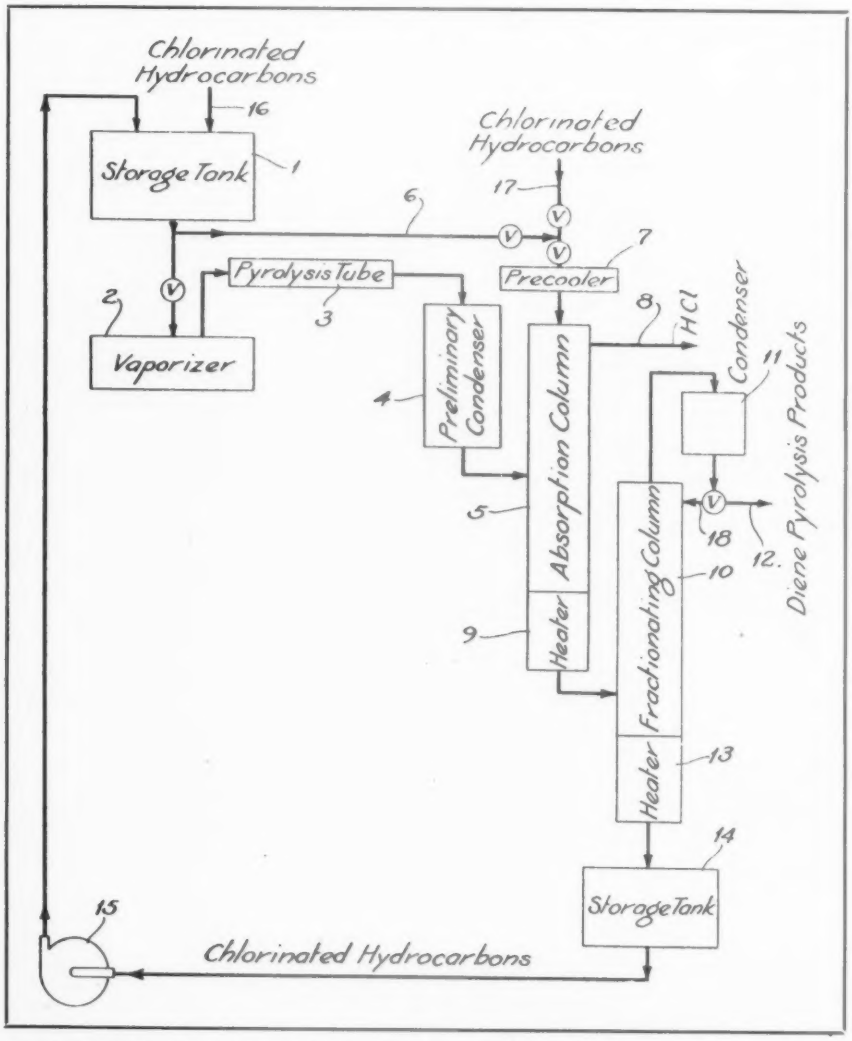


Fig. 2—Flowsheet for the continuous production of diolefins by pyrolisis of chlorinated hydrocarbons, patented by duPont

Selected Patents of the Month

Re. 22,671 (Shell)—Separation of diolefins.
U. S. 2,383,494-5 & 7-8 & 510 (Socony)—Lube containing P-S reaction product.
U. S. 2,383,521 (Sowa)—Separating wax from hydrocarbons by addition of organic silicane.
U. S. 2,383,535 (S.O. Ind.)—Propane fractionation of heavy oils.
U. S. 2,383,543 (S.O. Ind.)—Coal spray oil.
U. S. 2,383,547 (duPont)—Absorption and recovery of acetylene by cryogenic method.
U. S. 2,383,551 (Danciger Oil & Refineries)—Separating acetylene from gases.
U. S. 2,383,586 & 608 (S.O.D.)—Isomerization.
U. S. 2,383,606 & 869 (S.O.D.)—Pour depressor.
U. S. 2,383,642 (Gulf)—Depolymerizing olefin polymers.
U. S. 2,383,643 (S.O.D.)—Catalytic dehydrogenation.
U. S. 2,383,715 (de Jahn)—Gas mixture for methanol production.
U. S. 2,383,729 (Phillips Petrol.)—Catalyst chamber.
U. S. 2,383,752 (duPont)—Reacting paraffin hydrocarbon with SO_3.
U. S. 2,383,768 (Shell)—Addition of Ca naphthenate in solvent extraction.
U. S. 2,383,769 (Harvel Res. Corp.)—Raising m.p. of asphalt.
U. S. 2,383,772 (U.G.I.)—Resin forming hydrocarbons by pyrolysis.
U. S. 2,383,782 (Dow)—Rubberlike copolymers of diolefins and unsaturated ketones.
U. S. 2,383,784 (Shell)—Extracting diolefins with copper ammo. acetate.
U. S. 2,383,839 (Jasco)—Cured polymer mixture.
U. S. 2,383,904 (S.O.D.)—Soda soap grease.
U. S. 2,383,905 (S.O.D.)—E.P. lubricant.
U. S. 2,383,906 (S.O.D.)—Continuous method for making soap-thickened compositions.
U. S. 2,383,915 (Cities Service)—Lubricant containing diethylene glycol monoalkyl ether and Na soap.
U. S. 2,383,916-7 (Cities Service)—Lubricant containing liquid alkyl (butyl) lactate and E.P. agent.
U. S. 2,383,919 (Shell)—Di(tert.-butyl) peroxide recovery.
U. S. 2,383,921 (U.G.I.)—Purifying ring substituted methyl styrene.
U. S. 2,383,922 (U.G.I.)—Depolymerizing styrene polymers.
Brit. Appl. 2221/45 (Mallory Met. Prods.)—Spark plugs.
Brit. Appl. 2842/45 (Shell)—Polyallyl alcohol.
Brit. 570,868 (I.C.I.)—Cyclohexane.
Brit. 570,869 (I.C.I.)—Halogen substituted alkenes.
Brit. 570,835 (Shell)—Nitriles.
Brit. 570,870 (Shell)—Recovery of hydrogen halides from olefins.

References

(1) Oil, Paint & Drug Rep. 8/20/45 p. 7; *Technical Survey* 1945 p. 461.
(2) Ger. 479,079 (*I.G.*).
(3) U. S. 2,017,060 (*duPont*).
(4) Ber. 44, 52 (1911).
(5) Brit. 321,177 (*I.G.*).
U. S. 1,828,380 (*I.G.*)
U. S. 1,421,743 (*Chem. Found.*).

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Synthetic Fluid Cracking Catalyst

The demand for new high grade automotive fuels can be filled—quickly and efficiently—when your raw feed stock is cracked with AEROCAT*, synthetic fluid cracking catalyst.

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Improved Operating Techniques in Refining Will Accrue from Atomic Bomb Research

Development Work on Project Has Industrial Applications; Includes Improved Pumps, Instruments, Heat Exchangers, Leak Detectors, and Diffusion Barriers

IMPORTANT benefits to the petroleum refining and other processing industries, in the way of new types of equipment and plant operating techniques, will result from the development work on the $2,000,000 government atomic bomb project, it is predicted.

These advantages were described at a conference of industrial and business paper editors with the M. W. Kellogg Co., chemical and refinery engineers, Sept. 17 in New York. The Kellex Corp., a wartime subsidiary of the Kellogg Co., engineered through to construction and operation one of the major atomic bomb plants at Oak Ridge, Tenn. It included in its personnel a cross-section of the nation's scientific and engineering talent loaned for the war emergency by many companies.

Among peacetime technological advances resulting from the atomic bomb research project which were described as being important to petroleum refiners were the following:

Corrosion Prevention: New methods were worked out in developing the means for handling uranium in gaseous form as uranium hexafluoride, UF_6, a highly reactive compound. These include new techniques for pretreating metal surfaces, new piping arrangements, new packing and seals for pumps and others.

Pumps: New types of centrifugal blower pumps and syphon-sealed reciprocating pumps were developed. A significant advance in pump design, it was said, provides for utilization of supersonic velocities.

Barriers for Gas Diffusion. An entirely new type was developed and new techniques worked out for diffusional separation of gases. It is believed these may be applied in industry in isolating hydrogen from process gases and ethylene from cracked gas oil. Through its application also, means may be developed for separating natural gasoline fractions from crude oil without resorting to distillation. New types of fractionating columns for petroleum refining may also result, it was said.

Instruments: In working out the operating requirements for the diffusion plant at Oak Ridge, new types of precise, continuous, automatic analytical control instruments were provided, which will be available to industry.

Leak Detector: A highly sensitive device was developed for testing to insure that all parts of the gaseous diffusion plant were vacuum tight. Its application is seen in industry in locating exceedingly small leaks in high vacuum processing, in checking equipment and in testing welds, among other uses.

Heat Exchangers: A new type of individual cooling unit was worked out and thousands were installed in the Oak Ridge plant.

A great many tangible assets will accrue to American industry in the immediate future from knowledge gained in the successful solution of the problems faced in separating U-235 from natural uranium by gaseous diffusion methods, it was stated at the conference of writers by executives of the M. W. Kellogg Co. and Kellex Corp. Speakers included H. R. Austin, executive vice president of Kellogg Co. and A. L. Baker, general manager of Kellex.

It was brought out that the development work for the diffusion method had to be transformed from a highly theoretical concept, without even a laboratory process upon which to base design and performance data, into an efficient, multi-stage, commercial gas recycling process.

It is doubtful if such concentrated research was ever before brought to bear on any one problem. The total cost of merely separating the U-235 isotrope by the diffusion process in important volume reached a substantial portion of the overall figure of $2,000,000,000. Mistakes were made of course, because decisions had to be made quickly. These mistakes were capitalized on, however, and now the vast sum spent is to be considered not only as a necessary war expenditure or as a preliminary to developing super power resources in the future, but also as our government's contribution toward the betterment of industry as a whole.

Industry does not have to wait for atomic power to utilize the experience of the project, it was soon found out. Much has been learned which can be applied to more efficient processing in the near future. All that has been learned cannot be published at present but the know-how is in the minds of engineers and firms participating in the project and will be reflected in their future thinking, engineering design, construction and processing.

Following are some industries with indications of how they will benefit from knowledge gained in the U-235 problem, as enumerated at the conference.

1. **Petroleum refining**
   (a) improved pumping.
   (b) new type, more efficient heat exchangers.
   (c) mass spectroscope (continuous analytical control).
   (d) possible new methods of separating gasoline fractions.
   (e) improved automatic control.
2. **General chemical and processing industries.**
   same as in petroleum refining.
3. **Manufacture of pressure and vacuum vessels.**
   (a) checking welds.
   (b) pre-testing vessels for leaks before operation.
   (c) improved vacuum techniques.
4. **High vacuum industries.**
   (a) improved vacuum methods for vitamin distillation.
   (b) new methods of detecting high vacua in electronic tube manufacture.
   (c) low pressure, low temperature dehydration of foodstuffs.
5. **Gas processing industries.**
   (a) diffusional separation of helium from natural gas.
   (b) efficient separation of hydrogen from process gases.
   (c) diffusional separation of oxygen and rare gases from air.
   (d) new techniques in gas recycling.
6. **Electrical industry.**
   (a) new electronic techniques in high vacua.
   (b) improved micro-sensitive instrumentation.
7. **Medical profession.**
   (a) a low cost, more abundant source of radioactivity.
   (b) improved protective methods for combating toxicity in industry.
   (c) extension of cancer therapy.
8. **Refrigeration industry.**
   (a) increased safety in equipment.
   (b) improved handling of fluorides for refrigerants.
9. **Industries employing corrosive chemicals.**
   (a) new pump and valve lubricants and packing methods.
   (b) new treatment of metal surfaces to prevent corrosion.
   (c) improved safety practices.
   (d) completely enclosed pumps operated from exterior by induction.

Corrosion Factors

From the start of the project staggering obstacles loomed, it was stated. Uranium, being a solid, had first to be transformed into a gas for utility in the selected gas diffusion process. This meant selecting a compound of uranium with some other element which would be gaseous at nominal temperatures and from which elemental uranium could be

readily regained after diffusion. After much experimentation, which included uranium hexafluoride, UF_6, and also other gases, suitable process gases were selected for diffusion separation work.

One of the big advantages of UF_6, which brought it into special consideration, was that fluorine, having only one isotrope, would not complicate the sepa-

Key Scientists in Diffusion Plant Project of Atomic Bomb Research

ALBERT L. BAKER, Engineer, the M. W. Kellogg Co. In charge of all engineering connected with the gas diffusion plant at Oak Ridge; now General Manager of the Kellex Corp.

DR. HUGH S. TAYLOR, Consultant on Barrier Development. Dean of Graduate School, Princeton University. Assistant Director of S.A.M. Laboratory and in charge of barrier development for the Kellex Corp.

DR. CLARENCE A. JOHNSON, from the M. W. Kellogg Company, serving as Division Engineer on Barrier Development. Responsible for first production barrier actually used in plant.

GEORGE W. WATTS, Chief Engineer, Standard Oil of Indiana. While with Kellex he served as Division Engineer on Pumps and Instruments, and was responsible for Pump and Instrument development.

J. H. ARNOLD, from the M. W. Kellogg Co., serving as Division Engineer —Director of Research and Development

DR. A. O. C. NIER, from the University of Minnesota, serving as Division Engineer on Instrument Development. Pioneer in mass spectroscope invention and development. Identified with earliest separation of U-235.

DR. JUDSON SWEARINGEN, from The University of Texas, serving as Division Engineer on Pump design. Responsible for seal research.

A. M. SQUIRES, from the M. W. Kellogg Co., serving as Section Engineer on Process Design. Assistant to Dr. M. Benedict.

DR. M. BENEDICT, from The M. W. Kellogg Co., serving as Division Engineer on Process Design.

DR. RAPHAEL ROSEN, from The Standard Oil Development Co., serving as division Engineer on Special Chemicals with Kellex.

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REFINERY OPERATION & MAINTENANCE—*Partial Contents* (22 articles in all)—'M' Day for Refinery Equipment, Safety Precautions in Manufacturing Butadiene, Use of the Mass Spectrometer in Routine Analysis of Refinery Gas Samples, Refinery Corrosion Problems Review, and Maintenance and Repair of Refinery Turbines.

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ration by adding new combinations which would diffuse at varying speeds. Uranium hexafluoride is a solid at room temperature but fortunately turns into a gas at 56°C. Unfortunately, however, like most fluorine compounds, it is highly reactive, physiologically poisonous, and introduced problems of corrosion which pointed toward difficulties in production and handling. In the words of one Kellex spokesman "uranium hexafluoride is one of the hardest things to handle in the history of mankind."

It was learned that practically all the techniques and developments gained in the successful study of the problem could be carried over into a number of industries plagued by corrosion factors, through improvement in equipment and processing. The results indicated a saving of millions of dollars annually in the conservation of critical equipment and materials, minimum breakdown of moving parts and also increased safety for workers.

In the diffusion process it was imperative that no material in contact with the process gas react with it since such corrosion would lead not only to plugging of the microscopic pores of the diffusion barrier and various mechanical failures but also to absorption (i.e. virtual disappearance) of enriched U235 isotrope. Obviously, therefore, standard type valves and piping could not be used; instead, new methods of pre-treating metal surfaces against corrosion were worked out, new coolants, piping, new type heat exchangers, lubricants, pumps and packing were developed to satisfy the stringent requirements.

Application to Industry

Hydrogen fluoride is an important isomerization and alkylation catalyst in petroleum refining as well as an important raw material in the production of aluminum and refrigerants. It is, however, so highly active that industry has not yet capitalized on many of its potentialities. Its handling may now be made safer and simpler without excessive maintenance costs, and as a result its increased use in industry may be realized.

Other important starting materials for a host of industrial products such as sulfur dioxide, hydrogen chloride and the mineral acids (sulfuric, nitric and phosphoric) have all presented severe problems of transfer and corrosion with particular emphasis on valve lubricants and pump packings. These difficulties can be greatly simplified by application of the knowledge gained through the extensive experimentation with UF_6 and the other related gases.

Pumps

The work done on pumps in the Oak Ridge project is also believed applicable to modern industry. Thousands of pumps operating under reduced pressure created problems in vacuum technique on an unheard of scale. Other thousands operated at nominal pressures. But regardless of the type or service none could leak or corrode and all had to have as small a volume as possible. Many different types of centrifugal blower pumps and sylphon-sealed reciprocating pumps were tried out and new types developed. For example, in one of the pumps for the larger stages the impeller was driven through a coupling containing a very novel and ingenious new seal. Another type of pump was completely enclosed, its centrifugal impeller and rotor being run from the outside by induction.

Top flight pump designers from leading manufacturers in this country collaborated in research and succeeded to a remarkable degree in increasing industry's knowledge of this all-important phase of processing. For security reasons the practical applications of the new types of pumps developed cannot yet be made public. However, the engineers who participated in this phase of the project have brought to their parent companies a vastly increased lore of new techniques which cannot help but find their way into operating practice.

Perhaps the most significant advance in pump design which has been most successfully accomplished is the utilization of supersonic velocities of a very high order.

Barrier Requirements

Literally acres of porous barriers were required for the gas diffusion plant with billions of holes smaller than 0.01 micron (about two millionths of an inch). Despite the high degree of porosity required such barriers had to be able to withstand a pressure head of one atmosphere. The pores had to be of uniform size and spacing, must not become enlarged or plugged up as the result of direct corrosion or dust coming from corrosion elsewhere in the system, and the barriers had to be amenable to manufacture in large quantities and with uniform quality.

One of the major reasons for the lack of diffusion techniques in industry today has been the barrier problem. Few corporations could expend the time and money in the necessary research on this problem, until it was made necessary by the exigency of the situation. Almost at the last minute in the Oak Ridge project an excellent barrier was developed. Today these operate successfully throughout the more than several thousand stages in the plant.

Industrial Applications

Now that a large part of the basic research on diffusion barriers and their application to full scale industrial separations has been completed, particularly with reference to gas recycling and instrumentation, helium may be separated from natural gas by diffusion techniques rather than by the present refrigeration method, it is said. Helium is so light in comparison to other components of natural gas that its diffusion velocity through a porous barrier is over twice

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It may be even easier to isolate hydrogen by these new methods from a number of process gases now used merely as fuel because its diffusion velocity is over four times that of any compound associated with it.

The direct isolation of natural gasoline fractions from crude petroleum without resorting to distillation, and new types of fractionating columns for the petroleum refining industry also appear feasible.

Instrumentation

In the gaseous diffusion plant the problems of instrumentation were far greater than in any other industry because the theory involved the assumption that diffusion took place through an infinite number of stages whereas practicability dictated that such stages be limited in number.

Even so, several thousand stages were required, necessitating an intricate system of gas recycling involving abnormally large volumes of gases in relation to the finished product and continuous high precision analytical control. About half of the gas processed in each stage diffused through the porous barrier as enriched U-235 product, and after repressuring was sent on to the next higher stage for further concentration; the impoverished half was also repressured and recycled through the next lower stage. The recycling involved was enormous, over 100,000 times the volume of the final enriched gas.

There were developed to meet these needs the most precise, continuous, automatic, analytical control instruments ever produced, it was said at the conference. This refinement is one of the outstanding features of the gas diffusion plant and constitutes one of its most important applications to industry today. Instruments which before had existed only in research laboratories were improved upon and adapted to commercial use. Completely new prototypes were conceived, developed and put into mass production. The result is that now as never before there is available to industry a more nearly perfect system of continuous automatic control than has ever existed.

Mass Spectroscope

One of the developments in instruments at the Oak Ridge plant is a new type of mass spectroscope, believed to be applicable to the control of cracking operations and transfer line analysis. The mass spectroscope has been employed for several years in research laboratories and even within the last two years in certain phases of the refining industry but never on the perfected scale developed at Oak Ridge. Instrument engineers and physicists in this country and England devoted their full time not only toward gearing this instrument to continuous control but also to expanding this country's capacity for its quantity output.

Its potential uses in industry include the accurate analysis of natural gas or any process gas, the continuous automatic control of any gaseous process such as alkylation, dehydrogenation, vapor phase cracking, etc., the checking of inert gases such as nitrogen used to provide a protective atmosphere in furnaces, the checking of the completeness of any evacuation process as in the manufacture of radio tubes, the detection of impurities, and many others. Industry will not have to wait for benefit from this versatile tool because production facilities have been enormously increased since the new type was created.

Leak Detector

A device at the Oak Ridge plant aptly and simply called "the leak detector" is said to be more sensitive than any other existing device previously utilized for the same purpose. It played an important part in ensuring that all parts of the gaseous diffusion plant were vacuum tight. Any leaks out of or into the system would be damaging both from the standpoint of loss and contamination of an exceedingly valuable material. The leak detector is well adapted for locating leaks in industrial high vacuum processing industries. Other potential uses include the pre-testing of pressure and vacuum apparatus before putting it in service, checking equipment in operation to ensure no wasteful loss or contamination, the testing of welds for minute pores which would otherwise escape detection and ensuring the physiological safety of refrigeration equipment employing toxic coolants.

Heat Exchangers

Of great interest to the petroleum refining industry is the development of a new type heat exchanger. Since an unavoidable concomitant to pumping gas is heating it and since enormous volumes of gas were processed, individual cooling units for each stage had to be developed. A brand new type of heat exchanger was conceived for this purpose and developed up to the production stage. A manufacturer was then selected, shown how to make it even to the extent of redesigning his equipment so that thousands of units could be turned out quickly. They were installed and reported functioning successfully.

It was also brought out at the conference in New York that the wartime performance of the gaseous diffusion plant for the manufacture of U-235 from uranium was so outstanding that the authorities had selected this process alone for postwar use. The K-25 project, as the diffusion plant is known in government files, covers more than 600 acres and represents a cost of approximately $500,000,000.

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TABLE 6—Summary of Yields and Process Equipment (No Diesel to Sales)

Type Operation	Thermal Cracking Variable Thermal Reforming			Catalytic Cracking + Vis. Breaking Thermal Cracking T.C.C. Cycle Variable Thermal Reforming			Recycle Cat. Cracking Vis. Breaking + Thermal No Reforming	Recycle Cat. Cracking Vis. Breaking No Reforming
Case No.	5A	5B	5C	6A	6B	6C	7	8
Products, b/cd								
10 lb. R.V.P. Gasoline	5,529	5,638	5,804	6,168	6,309	6,541	6,796	6,239
Kerosine	1,500	1,500	1,500	1,500	1,500	1,500	1,500	1,500
No. 2 Fuel	.....	.....	.....	.....	.....	.....	.....	979
Residual Fuel	2,264	2,242	2,200	1,611	1,589	1,547	1,228	949
Excess Butane	21	.....	.....	115	70	.....	100	94
Dry Gas (F.O.E.)	888	825	711	826	764	650	552	375
Crude Run	10,000	10,000	10,000	10,000	10,000	10,000	10,000	10,000
Process Equipment, b/sd								
Crude Distillation	11,100	11,100	11,100	11,100	11,100	11,100	11,100	11,100
Thermal Cracking Gas Oil	.....	.....	.....	2,450	2,450	2,450	1,444	.....
Thermal Cracking Red. Cr.	6,225	6,225	6,225	1,665	1,665	1,665	1,665	1,665
Thermal Reforming	1,775	1,155	.....	1,775	1,155	.....	.....	.....
T.C.C.	.....	.....	.....	5,290	5,290	5,290	10,548*	10,548*
Catalytic Polymerization	254	200	77	437	402	348	368	322
Octane Nos.								
CFRM + 0 cc TEL	69.8	68.7	63.9	74.6	73.3	69.4	70.4	70.3
TEL to 76 CFRM	0.85	0.95	1.95	0.15	0.20	0.75	0.60	0.60
TEL to 78 CFRM	1.35	1.50	2.70	0.40	0.50	1.20	1.03	1.02
TEL to 80 CFRM	2.10	2.25	3.60	0.80	0.95	1.80	1.60	1.55
TEL to 82 CFRM	3.10	3.30	5.00	1.50	1.60	2.70	2.35	2.25

* Total Feed—1:1 Recycle Ratio.

TABLE 7—Summary of Yields and Process Equipment (Diesel to Sales)

Type Operation	Thermal Cracking Variable Thermal Reforming			Catalytic Cracking + Vis. Breaking Thermal Cracking T.C.C. Cycle Variable Thermal Reforming			Recycle Cat. Cracking Vis. Breaking + Thermal No Reforming	Recycle Cat. Cracking Vis. Breaking No Reforming—No Thermal
Case No.	1A	1B	1C	2A	2B	2C	3	4
Products, b/cd								
10 lb. R.V.P. Gasoline	4,740	4,843	4,975	5,346	5,491	5,722	5,941	5,516
Kerosine	1,500	1,500	1,500	1,500	1,500	1,500	1,500	1,500
Diesel Fuel	1,100	1,100	1,100	1,100	1,100	1,100	1,100	1,100
No. 2 Fuel	.....	.....	.....	.....	.....	.....	.....	658
Residual Fuel	2,067	2,045	2,003	1,391	1,369	1,327	1,078	949
Excess Butane	20	.....	.....	132	74	.....	70	74
Dry Gas (F.O.E.)	698	636	522	685	623	509	478	329
Crude Run	10,000	10,000	10,000	10,000	10,000	10,000	10,000	10,000
Process Equipment, b/sd								
Crude Distillation	11,100	11,100	11,100	11,100	11,100	11,100	11,100	11,100
Thermal Cracking Gas Oil	.....	.....	.....	1,870	1,870	1,870	1,100	.....
Thermal Cracking Red. Cr.	5,000	5,000	5,000	1,665	1,665	1,665	1,665	1,665
Thermal Reforming	1,775	1,155	None	1,775	1,155	.....	.....	.....
T.C.C.	.....	.....	.....	4,060	4,060	4,060	8,120*	8,120*
Catalytic Polymerization	200	170	.....	345	308	227	288	254
Octane Nos.								
CFRM + 0 cc TEL	69.8	68.2	62.7	74.0	72.7	68.3	69.2	69.0
TEL to 76 CFRM	0.75	1.10	2.10	0.13	0.30	0.85	0.75	0.75
TEL to 78 CFRM	1.20	1.60	2.90	0.35	0.65	1.30	1.20	1.20
TEL to 80 CFRM	2.00	2.40	3.80	0.73	1.15	1.90	1.80	1.75
TEL to 82 CFRM	2.90	3.50	5.30	1.30	1.80	2.75	2.60	2.50

* Total Feed—1:1 Recycle Ratio.

TABLE 8—Thermofor Catalytic Cracking Yields

Case Nos.	2	6	3	7	10
Tar Separator Charge, b/cd					
Diesel Fuel	.....	1,100	.....	1,100	.....
Topped Crude	4,500	4,500	4,500	4,500	4,500
Visbreaker Gas Oil	655	655	655	655	.....
TCC Recycle	.....	.....	3,655	4,755	.....
Total	5,155	6,255	8,810	11,010	4,500
Tar Separator Bottoms	1,500	1,500	1,500	1,500	1,500
Vacuum Gas Oil	.....	.....	.....	.....	900
TCC Reactor Charge, BPCD	3,655	4,755	7,310	9,510	3,900
Yields Based on Fresh Charge*, Vol.—%					
Debut. Motor Gasoline	42.0	41.6	56.0	55.5	42.6
Catalytic Gas Oil	46.0	46.5	27.0	27.5	46.2
Isobutane	3.7	3.8	7.0	7.0	3.7
Normal Butane	1.5	1.5	2.0	2.0	1.5
Butylenes	4.7	4.6	5.9	5.8	4.9
Propylene	3.3	3.3	3.9	3.8	3.4
Dry Gas (F.O.E.)	7.6	7.3	8.9	8.3	7.8

* Includes Visbreaker Gas Oil but Excludes TCC Recycle.

illustrate the relation of catalytic and thermal cracking under the basic conditions assumed. Fig. 3 illustrates the relative earnings per year for thermal and catalytic cracking. It will be noted that over the entire range of octane numbers the earnings for catalytic cracking far exceed those for comparable thermal creacking; also, as might be expected, recycle catalytic cracking involving the highest production of catalytic gasoline also shows the highest earnings.

Fig. 4 has been constructed to show the value of catalytic cracking in relation to the increased investment required. Earnings above investment have been determined for a period of 10 years for both thermal and catalytic cracking

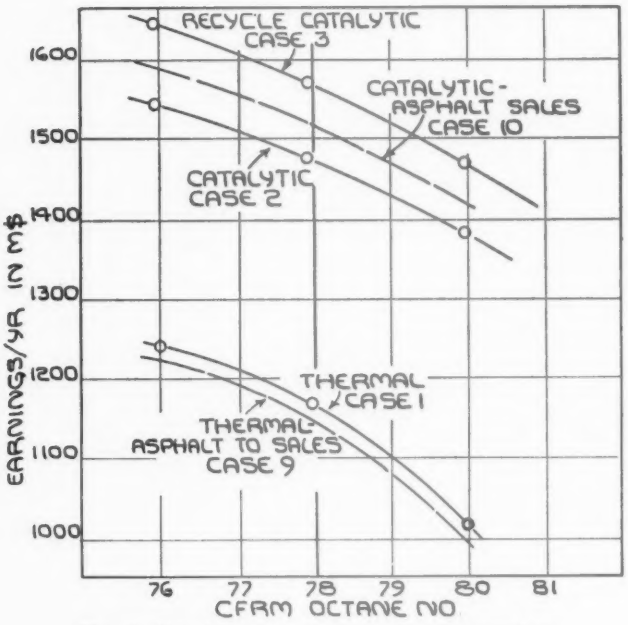

Fig. 3—Earnings per year vs. octane number

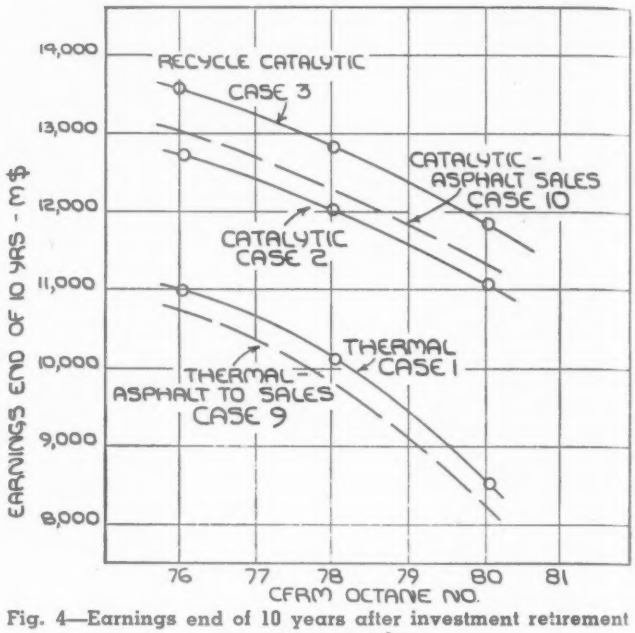

Fig. 4—Earnings end of 10 years after investment retirement vs. octane number

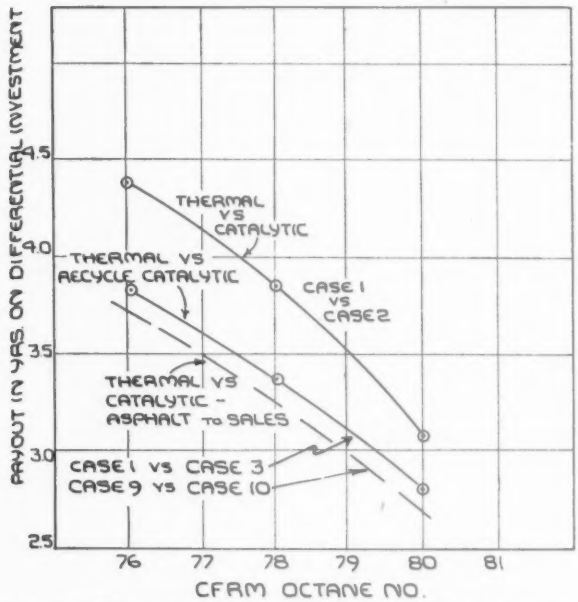

Fig. 5—Differential retirement period vs. octane number

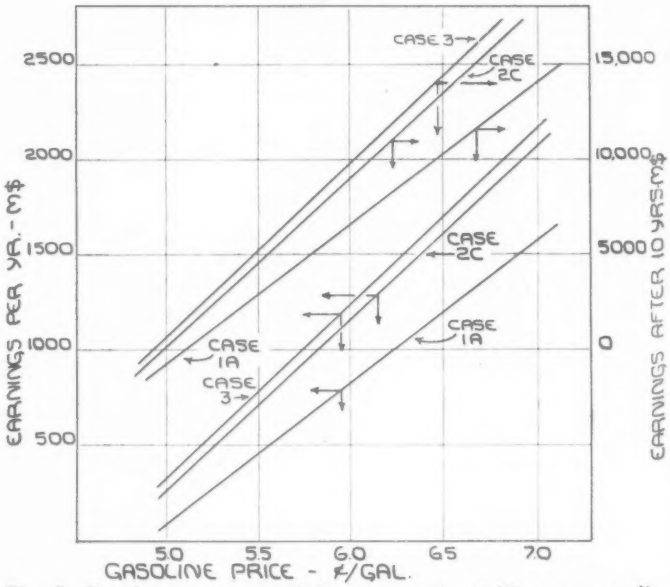

Fig. 6—Yearly earnings and 10 year cash position vs. gasoline price

TABLE 9—Thermal Cracking Yields

Case Nos.	1	5	2, 3, 4 6, 7, 8	3, 7	9	10
Charge Stock, b/cd						
Gas Oil	.....	.....	.....	.....	3900	.....
Reduced Crude	4,500	5,600	1,500	.....	.....	.....
Catalytic Gas Oil	.....	.....	.....	987 & 1308	.....	1,799
Gravity, °API	25.0	27.0	15.5	25.0	26.5	30.0
Yields, Vol.—%						
Debut. Motor Gasoline	44.1	47.7	13.1	36.0	50.0	41.5
Isobutane	0 6	0.7	0.3	1.0	0.9	0.9
Normal Butane	2.0	2.4	0.9	3.2	2.4	3.0
Butylenes	2.1	2.5	0.7	2.8	2.7	2.6
Propylene	1.9	2.2	.....	2.5	2.2	2.8
Visbreaker Gas Oil	.....	.....	43.7	.....	.....	.....
Fuel Oil	44.5	39.3	41.3	46.5	35.0	42.0
Dry Gas (Wt.—%°)	8.5	9.0	2.3	13.0	12.0	10.0

°C_3 and Lighter.

cases. The difference between straight thermal cracking and recycle catalytic cracking at the end of 10 years is shown to be approximately $2,500,000 at a 76-octane level and $3,250,000 at an 80-octane level. It will be noted that no comparison is shown above 80-octane number since such an operation would be impractical without excessive use of tetraethyl lead for straight thermal cracking.

Fig. 5 illustrates, as a function of octane number, payouts of the differential investment between catalytic and thermal cracking. These payout periods are, of course, of only relative significance since a careful analysis of each individual refinery situation is necessary before the true picture can be determined. Investment figures are predicated upon

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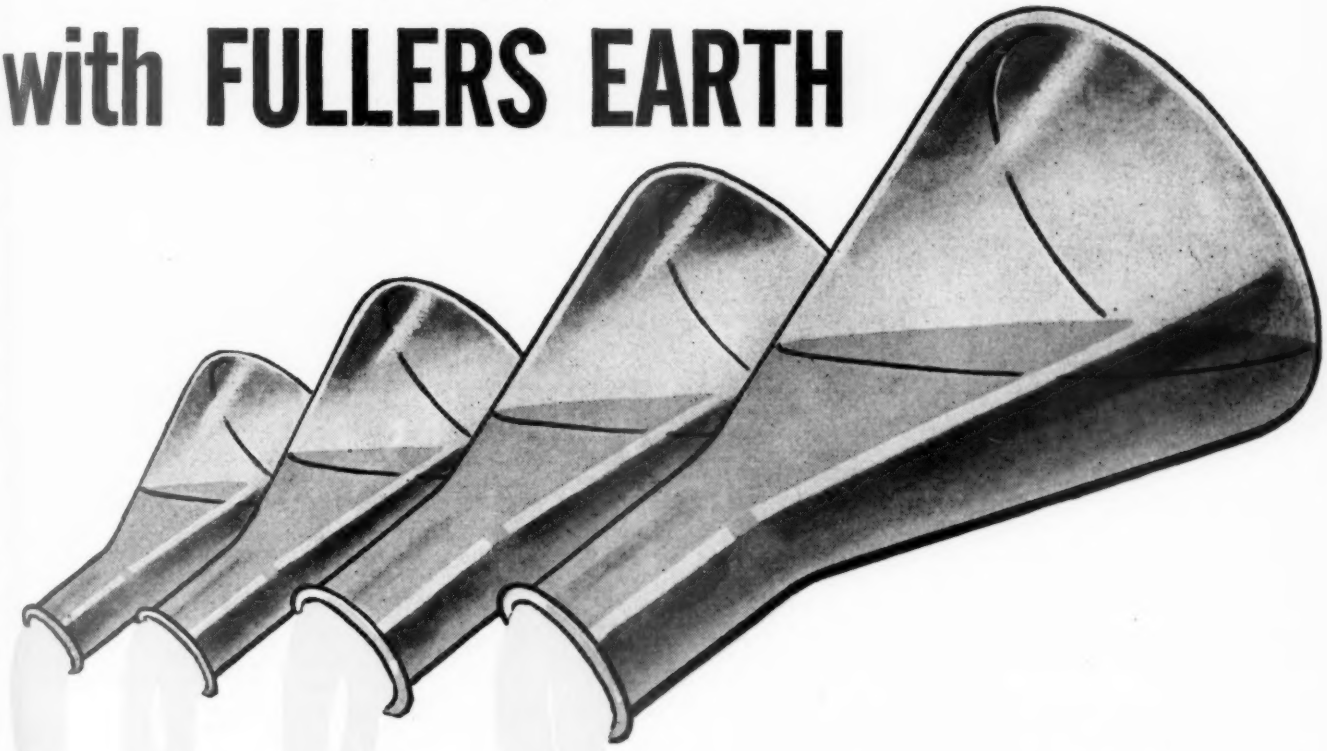

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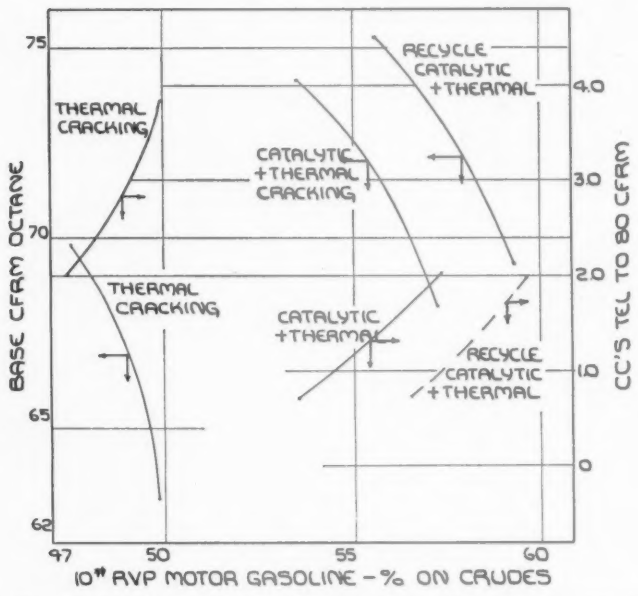

Fig. 7—Gasoline yield vs. base octane rating and amount of TEL needed to raise rating to 80 CFRM, with diesel fuel to sales

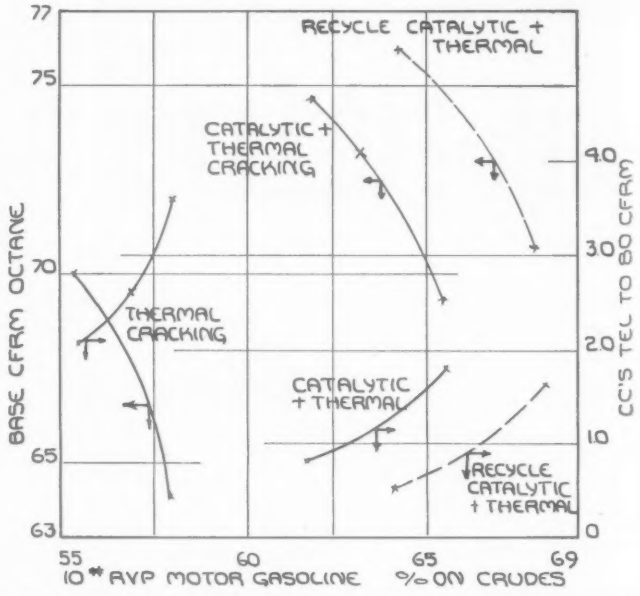
RECYCLE CATALYTIC + THERMAL
CATALYTIC + THERMAL CRACKING
THERMAL CRACKING
CATALYTIC + THERMAL
RECYCLE CATALYTIC + THERMAL
BASE CFRM OCTANE
CC'S TEL TO 80 CFRM
10# RVP MOTOR GASOLINE % ON CRUDES

Fig. 8—Gasoline yield vs. base octane rating and amount of TEL needed to raise rating to 80 CFRM, with diesel fuel to cracking

normal construction costs. While it is recognized that such figures may vary with local labor conditions and individual refinery specifications, those used in this report are consistent and therefore comparable. Often utilization of existing equipment in conversion of thermal to catalytic cracking will reduce investments very substantially and make the payout even more attractive.

Fig. 6 shows the effect of refinery gasoline price on earnings per year and earnings after 10 years taken at the 80-octane level.

Figs. 7 and 8 illustrate the octane yield relationship for thermal cracking, once-through catalytic and recycle catalytic cracking. These graphs make it evident that not only is there a large advantage in gasoline octane number and TEL requirement for catalytic cracking but there is also a very substantial advantage in over-all gasoline yield. For example, when producing 80-octane number motor gasoline containing about 2 cc TEL, there appears to be a yield advantage of 12-13% for recycle catalytic cracking over thermal cracking only. Fig. 9 illustrates lead requirement, as a function of octane number, for several of the cases studied. These curves emphasize again the value of catalytic cracking in producing high octane number gasolines of low TEL content.

Delayed coking for the preparation of gas oil charge is a highly attractive process for those refiners who desire a minimum of heavy fuel oil and who can dispose of petroleum coke.

The studies presented in this paper lead to a number of interesting and practical conclusions:

1. T.C.C. catalytic cracking is now available for the small refiner. Studies have been prepared which show that the process is feasible for the refiner processing 3000 or more b/d of crude oil.

2. The competitive market for motor fuel points toward higher gasoline octane numbers in the future. Catalytic cracking will, in many cases, be the only means of economically reaching those competitive levels.

3. The earnings from catalytic cracking at a given octane level are, in nearly every case, sufficiently greater than for thermal cracking to justify its installation.

4. Reduction in yield of residual fuel makes for greater flexibility in meeting many local market conditions.

5. Substantial investment savings can be achieved in many cases by using existing thermal equipment.

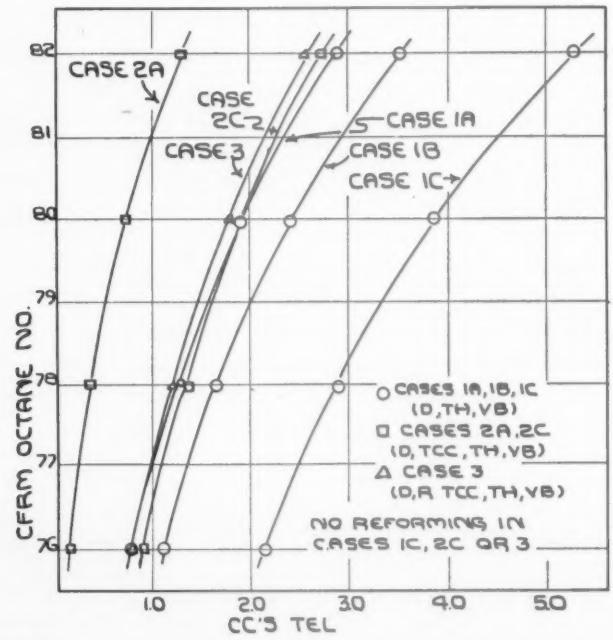

Fig. 9—TEL requirements vs. octane numbers

TABLE 10—Reforming Yields

Case Nos.	1-A	2-A	1-B	2-B
Naphtha Charge, b/cd	1,040		1,600	
Charge Octane No.	46.0		49.0	
Yields, Vol.—%				
Debut. Motor Gasoline	76.4		76.4	
Isobutane	1.2		1.2	
Normal Butane	3.1		3.1	
Butylenes	4.3		4.3	
Propylene	3.3		3.3	
Fuel Oil	4.0		4.0	
Dry Gas (Wt.—%)	15.0		15.0	
Debut. Motor Gasoline Octane No.	68.0		69.0	

NEW BOOKS FOR THE REFINER

Bulletin on Hydrogen Sulfide Poisoning

Hydrogen Sulfide Poisoning as a Hazard in the Production of Oil, by Sara J. Davenport, Information Circular 7329, U. S. Bureau of Mines, Department of the Interior, Washington.

Recognizing the more widespread use in recent years of high-sulfur content crudes by oil companies, the U.S. Bureau of Mines has issued a new publication calling attention to this hazard in the petroleum industry. The bulletin describes the physiological action of the gas, treatment for hydrogen sulfide poisoning, preventive measures and detection of the gas in the air. It also contains an extensive bibliography of previous Bureau of Mines publications and other articles of general interest on the subject. For more than two decades the Bureau has conducted research on the toxicity of hydrogen sulfide.

Copy of the publication, Information Circular 7329, *Hydrogen Sulfide Poisoning as a Hazard in the Production of Oil*, by Sarah J. Davenport, may be obtained by writing the U.S. Bureau of Mines, Department of the Interior, Washington.

Methods for Identification Of Hydrocarbons Described

The Chemical Constituents of Petroleum, by A. N. Sachanen; 6 x 9 in., 450 pages, stiff cloth binding, $8.50.

The application of chemical refining methods in the petroleum field and the closer separation of products now being practiced in commercial operations gives greater importance to methods for the identification, by their chemical composition, of individual hydrocarbons and their groups. *The Chemical Constituents of Petroleum*, by A. N. Sachanen brings together a large amount of data from the literature on the content of various types of hydrocarbons, expressed in terms of ring analysis and of conventional classes, together with the physical and chemical methods for determining the structures and classes.

Recognizing that the problem of separating individual chemical constituents is almost hopeless for the high-boiling fractions which may contain an innumerable quantity of various entirely unknown hydrocarbons and other compounds, the author points out that the separation and quantitative determination of different classes of hydrocarbons and other constituents may be as important as the separation and identification of individual compounds.

In the chapter on hydrocarbons of straight-run distillates it is pointed out that the separation of individual hydrocarbons from the petroleum fractions is a difficult problem that so far has been solved only for comparatively few fractions, including the kerosines of a few crude oils. "It seems certain, however," says the author, "that the wide commercial segregation of individual hydrocarbons from liquid petroleum products is a problem of the near future. Such hydrocarbons as toluene, cyclohexane, methylcyclopentane, methylcyclohexane and a series of normal paraffins may be produced commercially from straight-run gasolines."

One chapter is given over to the properties and composition of fractions from synthetic fuels, synthetic lubricating oils and similar products manufactured from petroleum by thermal and catalytic cracking. Included are polymer gasolines, cracked gasolines, hydrogenation gasolines, synthetic gas oils and synthetic petroleum resins, among others.

"An attempt to develop the chemical classification of crude oils on the basis of the content of various classes of hydrocarbons has been made . . . .", it is stated in the chapter on the classification of crude oils. "The drawback to this classification was the disregard of resinous and asphaltic compounds which were associated with aromatic hydrocarbons." Along this line, a new attempt is made in this work to classify crude oils on the basis of more complete data on chemical composition available at present, including the data of ring analysis.

The oils are classified according to the content of paraffinic constituents, i.e. paraffin hydrocarbons and paraffinic side chains, naphthenic and aromatic constituents and resinous-asphaltic compounds.

The author, A. N. Sachanen, D.Sc., is a member of the Research and Development Department of Socony-Vacuum Oil Co., Inc. He is well known for his contributions to the literature on the chemistry of petroleum including, as co-author, the books *Chemistry and Technology of Cracking* and *Crude Oils and Oil Products*.

Copies of all books reviewed on this page can be ordered from the Book Department of *National Petroleum News*, 1213 West Third St., Cleveland, 13, for the prices listed, postpaid. Ohio purchasers please add 3% sales tax.

TECHNICAL MEETINGS FOR OIL MEN

OCTOBER

26-30, American Society of Mechanical Engineers, annual meeting, Hotel Pennsylvania, New York City.
12, California Natural Gasoline Assn., annual fall meeting, Biltmore Hotel, Los Angeles, Calif.
24, American Gas Association, annual meeting, Engineering Societies Bldg., New York City.

NOVEMBER

12-15, American Petroleum Institute, annual meeting, Stevens Hotel, Chicago, Ill.

APRIL

18-19, National Petroleum Association, semi-annual meeting, Hotel Cleveland, Cleveland, Ohio.
17-19, Natural Gasoline Assn. of America, annual convention, Baker Hotel, Dallas, Texas.

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CORROSION PREVENTIVES—(By C. M. Larson)—New type petroleum preservatives developed to protect equipment during storage and transportation offer wide industrial application.

ENGINE OIL FOAMING—(By H. A. Ambrose & C. E. Trautman)—Progress Report of the Group on Foaming, Engine Oil Division, CRC Coordinating Lubricants Research Committee.

KINETICS OF THE PROCESS OF THERMAL POLYMERIZATION OF BUTADIENE—(By S. V. Lebedev, M. A. Khoklovkin, N. I. Kuibina and others)—Translation from Russian scientific literature by Dr. J. G. Tolpin.

MECHANICAL OPERATION OF HF ALKYLATION UNITS—(By R. A. Findlay)—A presentation and discussion of the future design and construction of HF alkylation units as established by the actual operating experience of the units.

NEW DEVICES SAVE TIME AND LABOR IN SETTING UP ENGINE TEST STANDS—Story of an oil company's automotive laboratory, with detailed descriptions and illustrations.

NEW METHODS OF FIGHTING OIL FIRES ARE GIVEN FULL-SCALE TESTS IN 93-FT. TANK—(By W. F. Bland)—Effectiveness of Mechanical Foam and of Water Spray are demonstrated in Four-Day Experiments on 32,000-bbl. crude storage tank.

SERVICE PERFORMANCE OF LUBES AND GREASES VASTLY IMPROVED DURING WAR—(By C. M. Larson)—Tells how the petroleum industry's development in lubricants have made great improvements in motor oils, aircraft engine oils, gear lubricants, chassis and wheel bearing greases, hydraulic fluids, and rust preventives, as well as chemical additives for each and every lubricant.

STOP ACCIDENTS IN SMALL PLANTS, TOO—(By Wm. C. Uhl)—Points out the practicability of organized safety programs for small plants; results include greater efficiency, higher morale and lower insurance rates.

Mail your requests for the above free reprints to: Readers' Service Department, National Petroleum News, 1213 West Third Street, Cleveland 13, Ohio.

R-845

Petroleum Technologists in the Headlines

The graduate department of Agricultural and Mechanical College of Texas has been further strengthened by the appointment of **Dr. P. G. Murdoch** as Professor of Chemical Engineering. Dr. Murdoch is a graduate of California Institute of Technology and has worked for Shell Oil Co. for the past 12 years in various technical capacities, spending most of his time in California.

Mr. Murdock

Dr. Murdoch will teach graduate courses and carry out research. He will act as a consultant for some of the various cooperative research projects established at Texas A & M and his appointment is a continuation of the increased emphasis on graduate study which began a year ago.

♦ ♦ ♦

Charles Z. Hardwick, assistant manager of the refining and marketing department of Ohio Oil Co., has been elected a vice-president and will succeed **C. L. Fleming** as manager of the refining and marketing department. Mr. Fleming is retiring. Mr. Hardwick started with the Ohio Oil Co. in 1921 as a clerk in the Haynesville, La., field office. Since 1934 he has been in the company's headquarters in Findlay, O.

♦ ♦ ♦

Wilson B. Emery, now vice president and manager of production of Ohio Oil Co., has been elected to the board of directors to fill the vacancy caused by the retirement of Mr. Fleming. Dr. Emery, who did his undergraduate and graduate work in Yale university, specializing in geology, joined Ohio Oil Co. in 1919 and served first in the Rocky Mountain division. In May, 1944, he was placed in complete charge of the company's production operations, with headquarters in Findlay.

♦ ♦ ♦

Dan M. Guy has been made manager of the agricultural division of the Technical Service Department of Ethyl Corp., and will make his headquarters at the company's Engineering Research Laboratories at Detroit. Mr. Guy, a graduate of Georgia School of Technology, joined the sales department of Ethyl Corp. in 1931 and for the past 10 years has specialized in agricultural engineering, working with tractor manufacturers on problems in connection with the proper utilization of fuels in tractors.

Oscar M. Duncan, formerly with Allied Oil Co. and Socony-Vacuum Oil Co., Inc., is now chief chemist of the Indiana Farm Bureau Co-Operative Assn.'s refinery at Mount Vernon. He succeeds **Clark Anderson** who will take charge of plant operations.

♦ ♦ ♦

Philip E. Rice is manager of the Los Angeles Synthetic Rubber plant operated for the government by the U. S. Rubber Co., succeeding **F. S. Carpenter,** who has been transferred to the company's New York offices. Mr. Rice had been manager of the company's Naugatuck Chemical plant. He started with the company in 1925 as a research chemist.

♦ ♦ ♦

William W. Robinson, Jr. is chief chemist of the new technical service and research laboratory which the Pacific Coast division of The Texas Co. is locating at Signal Hill, Cal. He was formerly chief chemist of the gasoline laboratory. In 1926 Mr. Robinson was made chief chemist of the California Petroleum Corp.'s natural gasoline laboratory, which later became part of The Texas Co.'s facilities. In 1931 he became director of gas research of The Texas Co.'s Beacon, N. Y., research laboratory, returning to California in 1933.

♦ ♦ ♦

E. R. Barnard, assistant director of research, Standard Oil Co. (Indiana) and **Dr. T. H. Rogers,** associate director of research, were among a group of 12 Whiting refinery personnel who have received certificates of merit from the Office of Scientific Research and Development in appreciation of their research on a military flame thrower project, which resulted in an explosion on the refinery grounds in May, 1944. Mr. Barnard is still convalescing in Florida from burns incurred and Dr. Rogers has recovered from serious burns.

Frank Ovitz and **James G. Nellis,** chemical engineers, died as a result of the explosion and were posthumously honored. **James A. Bock** and **R. B. Terry,** chemical engineers, and **W. A. Proell,** chemist, were among the 12 receiving the certificates of merit.

♦ ♦ ♦

W. F. Moore has been appointed general manager of foreign operations for The Texas Co. Mr. Moore has been affiliated with the company for 25 years, serving in the refining department in various engineering capacities, in the domestic and foreign fields in connection with patents, and as chief purchasing officer. In 1943 he was assigned to foreign operations as assistant to the vice president, acting in an administrative capacity.

H. R. Kemmerer, who has been chief chemist at the research laboratory of the Wood River refinery of Shell Oil Co., Inc., has been made research director of the manufacturing research laboratory of the Houston refinery. He started with the Shell company in 1935 as junior mechanical engineer at Wood River; in 1939 became a senior research engineer and two years later was made senior applications engineer. In 1942 he was made head of the products application department at Wood River, in 1944 chief research chemist and earlier this year chief chemist.

F. F. Farley has been appointed chief chemist at Shell's Wood River research laboratory to succeed Mr. Kemmerer. He started with the company in 1942 as a senior research chemist. A graduate of St. John's University in Toledo, he received his M. S. in organic chemistry from University of Detroit and a Ph. D. in plant chemistry at Iowa State College.

♦ ♦ ♦

John B. Macauley is director of engineering research for Ethyl Corp., succeeding **Earl Bartholomew** who is to become general manager of research laboratories. Mr. Macauley has been chief of applied research for Pratt and Whitney Aircraft for the past two years and for many years before that he was chief of the engine laboratory of the Chrysler Corp. A native of Washington, he attended the University of Illinois and served in France in the First World War as gunner in the first marine aviation force.

Mr. Bartholomew

Mr. Macauley

Mr. Bartholomew has been associated with Ethyl Corp. since 1926 and has been director of engineering research since 1927. A native Oklahoman, he received his B.A., B.S., and M.S. degrees from the University of Oklahoma. He taught mechanical engineering there one year and at Harvard for three years.

♦ ♦ ♦

Carl R. Culverhouse, Jr., is on the research and development staff of Anderson-Prichard Oil Corp., Cyril, Okla.

Col. Carl E. Cummings has been made superintendent of the Texas Co.'s research laboratory at Beacon, N. Y., to succeed the late **Allan V. Ritchie.** He was recently released from the Army, where he served as deputy chief petroleum officer for the European theatre of operations.

Col. Cummings

Col. Cummings joined The Texas Co. in 1933, after graduating from Johns Hopkins and was engaged in engineering research until he joined the Army in 1941. A member of the Officers Reserve Corps, he entered service as a Captain. Before going overseas in December, 1943, he was deputy chief of engineers, specification section, engineer branch, at the tank and automotive center in Detroit. He was made a Colonel in 1944 and in 1945 was given the Legion of Merit decoration for his part in supplying the armed forces in Europe with petroleum products.

♦ ♦ ♦

Dr. Donald Babcock Keyes, director of the office of production, research and development of the War Production Board, has been elected to receive the Honor Scroll of the American Institute of Chemists. This is awarded annually for outstanding contributions to the world in chemistry or chemical engineering. The presentation will be made at a dinner in Chicago Oct. 26. Dr. Gustav Egloff, director of Research, Universal Oil Products Co., is president of the Institute.

Dr. Keyes, who is on wartime leave from his position as head of the Chemical Engineering Division of the University of Illinois, is honored for his achievements in chemical engineering practice, in teaching and in wartime service to the government.

♦ ♦ ♦

Charles F. Foell has severed his connection with "Diesel Power and Diesel Transportation", as editor. Mr. Foell is now affiliated with Socony-Vacuum Oil Co. Inc., New York City, where he will be in the technical division of the Industrial Lubrication Department.

♦ ♦ ♦

Formerly research engineer, Shell Oil Co., Inc., Wood River, Ill., **William S.** Wilson is now associated with the Socony-Vacuum Oil Co. Inc., Technical Service Division, Brooklyn, N. Y., in an engineering capacity.

♦ ♦ ♦

D. M. Brown, formerly with the Engine Research Laboratory of the Armour Research Foundation, is now assigned to a U. S. Petroleum unit in the China-Burma-India Theater.

M. G. Gamble has been made general manager of the marine department of Standard Oil Co. (New Jersey). As assistant general manager during the war he was active in coordinating the operations of the Esso tanker fleet while it was under requisition to the War Shipping Administration. A graduate of the U. S. Naval Academy in 1915, Mr. Gamble spent several years in naval service, resigning to enter the construction and repair division of Jersey Standard's marine department. After two years in machinery construction work he was transferred to the operating division, spending some years directing shipping activities in Venezuela and the Caribbean.

♦ ♦ ♦

Dr. H. C. Lawton, Emeryville, Cal., oil production research chemist, has accepted an appointment with the Pennsylvania Grade Crude Oil Assn., in its production research laboratory at Bradford, Pa. He has been on the research staff of Shell Development Co. at Emeryville since 1937 and earlier was with Mellon Institute and Gulf Research and Development Co., Pittsburgh. A native of California, he studied in the University of California and received his master's degree and doctorate from the University of Pittsburgh.

♦ ♦ ♦

T. A. Boyd, head of the fuel department, Research Laboratories Division, General Motors Corp., has been elected vice-president of the American Society for Testing Materials to serve two years. Mr. Boyd was co-discoverer with Charles F. Kettering and the late Thomas Midgley, Jr., of the antiknock effects of the liquid compounds of lead. He has been active on committees of the S.A.E., A.S.T.M., A.C.S., the Coordinating Research Council, and other technical groups for years. He served as president of the Engineering Society of Detroit for the 1943-1944 term.

♦ ♦ ♦

Robert E. Paterson, a recent graduate in organic and engineering chemistry from Stanford University, is an assistant production engineer in the production technical laboratory of Standard Oil Co. of California at La Habra, Cal.

♦ ♦ ♦

Jules J. Perot, Jr., formerly chemist in the research and development division of Socony-Vacuum Oil Co., Inc., Paulsboro, N. J., is now in the research laboratory of the Flintkote Co., Rutherford, N. J.

♦ ♦ ♦

George Krieger, former manager of the agricultural division, who recently returned to Ethyl Corp. after two years leave of absence with the War Production Board as chairman of the farm machinery and equipment division, has been appointed special assistant to Julian J. Frey, general sales manager.

James W. Cowles, Tulsa, formerly assistant manager Natural Gas Department of Shell Oil Co., Inc.'s Midcontinent area office, now is managing the Natural Gas-Gasoline Division although eligible for retirement. Mr. Cowles has been with the Tulsa office for the past 20 years.

Prior to joining Shell, Mr. Cowles was with Skelly Oil Co. and the old Oklahoma Petroleum and Gasoline Co. at Tulsa; still earlier with the Department of the Interior, Five Civilized Tribes, Muskogee, Okla. The Natural Gasoline Assn. of America presented him the Hanlon Award in 1938 for his outstanding services in gas contract simplification, a subject on which he is considered one of the leading authorities, according to N. G. A. A. Secretary, W. F. Lowe.

♦ ♦ ♦

Leonard Raymond has recenty been appointed assistant supervisor, Automotive Laboratory, Socony-Vacuum Oil Co., Inc., Paulsboro, N. J. Mr. Raymond was formerly associated in a similar capacity with Tide Water Associated Oil Co., Bayonne, N. J.

♦ ♦ ♦

William B. Hudson, of the Foster-Wheeler Corp., has been elected president of the Junior Chemical Engineers of New York for the year 1945-46. **Maurice R. Lyons** (M. W. Kellogg Co.) is vice-president, and **Richard Rosencranz** (Shell Oil Co.) is secretary-treasurer.

ADVERTISERS' INDEX

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WIDENING HORIZONS

Views on Personnel, Management and Economic as Well as Technological Developments in Petroleum Refining and Natural Gas Processing: Comment from Readers Is Invited

Patent System "Reforms" Have No Part In the Government's Research Program

IN some quarters, principally in Washington, it is believed that the program for coordinating scientific research, directed by a government agency, must provide that any invention or discovery resulting from government-financed projects become public property. This line of thinking is of the greatest importance to all technologists and industrial executives. Such a provision would not only change our present patent system by depriving many inventors of the fruits of their work; more important still, in connection with the proposed research program, its effect would be to stifle research effort rather than to stimulate it.

This theory that the making public property of new inventions and discoveries would quicken scientific progress in this country was voiced by President Truman in his message to Congress on September 6th.

The same principle is held by Senator Kilgore of West Virginia who has presented Congress with his ideas for coordinating research work to the end of aiding our national defense and promoting our public welfare. He states in his recent report:

"To protect the taxpayer's interest, all research and development projects financed in whole or in part by the Federal Government should be undertaken only upon the condition that any invention or discovery resulting therefrom would become the property of the U. S."

There is a two-fold danger in this theory as it is made a part of the proposed government-supported research program. The first is that, if it became effective, it would result in a fundamental change in our patent system. It would be a back-door "reform", since at least two other agencies, at the request of the President, are now making a comprehensive study of the patent system, with a view to suggesting necessary changes. The second danger is that it promotes an erroneous principle; namely, that the making public property of inventions and discoveries would quicken scientific progress.

The public conception of a patent that seems to be encouraged in certain circles in Washington is that it is a franchise; that, when a patent is granted, the public and other inventors are deprived of certain definite rights. Actually, however, that is not true. Moreover, a patent in most cases lacks the practicality of a method for successful commercial application. This comes only as a result of long and costly development work, which private enterprise will undertake if other conditions are favorable, provided it has the incentive of patent rights. Again a patent in a new field many times has served to stimulate competitors to renewed research work carried on independently, which has brought forth other new developments of benefit to the public. It is doubtful in either case if the long research and development work necessary after the granting of a patent would be carried on, if the patent were public property and available to everyone to use.

In our own petroleum industry, technological progress has been extremely rapid during the last 15 to 20 years particularly. New discoveries and inventions have been brought forth that have greatly improved producing and refining methods and resulted in better products at lower cost to the public. These have been entirely the result of research of private enterprise.

Yet, in this same period, studies and experimental work in the petroleum industry have been carried on widely by one important government agency, the Bureau of Mines, which maintains on its staff many good scientists. The results of their studies of fundamental problems, as for example salt water disposal, evaporation and so on, are public property and they have been of value to many oil companies. The Bureau of Standards, another government scientific agency of high standing, by its work in isolating individual hydrocarbons and determining their characteristics, has contributed a great deal to the fundamental knowledge of the industry.

From the work of these scientific bureaus, however, as far as is known, no new process or method has been forthcoming which by its wide commercial application has aided technologic progress in the industry. On the other hand, to take one example, the discovery and development of the thermal cracking processes by private enterprise, with the incentive of acquiring patent rights, has conserved hundreds of millions of barrels of crude oil and given improved motor fuels to the public at lower costs. No Congress would have voted the funds necessary to bring these inventions in the thermal cracking field to the point of commercial application. Also, had they been public property, no individual company or group of companies could have afforded to spend the money necessary to develop them for commercial application.

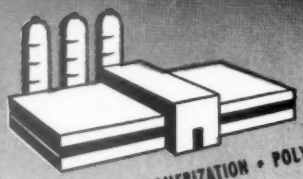
What is everybody's business is nobody's business. If the results of research financed in any way by the government were public property, the further development work necessary to practical application of the invention would lag. Research workers in any institution where government research was under way might hesitate to announce an important discovery but wait until they could resign and work out their discovery in a private laboratory. Under such a patent policy it is doubtful if the government would have the cooperation of outside research institutions necessary to a successful complete research program.

The report of Dr. Vannevar Bush with his group of prominent scientists proposing a centrally administered research program recognizes that there are instances, in any such program, where it would be to the public interest to place new inventions at the disposal of the public. The administrative agency for the program would be authorized to decide in such cases. The Bush report, however, proposes a program that would operate within the present patent system. It states, "There should be no obligation on the research institution to patent discoveries made as a result of support from the Foundation. There should certainly *not* be any absolute requirement that all rights in such discoveries be assigned to the government, but it should be left to the discretion of the director . . . whether in special cases the public interest requires such an assignment."

There are now before Congress five bills relating to a scientific research program. Hearings on some of them are scheduled to start early in October. They raise many questions which affect the future of every oil company technologist and industrial concern. Certainly one of the most important points is whether, directly or indirectly, changes in the patent system are to be included in the program.

America's scientists will do well to watch the progress of this legislation closely—and voice their own opinions on the subject.

reaching out to tomorrow...



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